THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 53 Thursday, November 28, 1935 No. 1006

PUBLISHED WEEKLY

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

PRESIDENT: 1935-36
J. E. Hurst, "Ashleigh," Trent Valley Road, Lichfield, Staffs.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands: A. A. Timmins, A.I.C., 21-23, St. Paul's Square, Birmingham.
Sheffield: T. R. Walker, "The Priory," Oughtibridge, near Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.
London: H. W. Lockwood, Stewarts and Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.
Newcastle-upon-Tyne: W. Scott, Sir W. G. Armstrong, Whitworth & Company (Ironfounders), Limited, Close Works, Gateshead-on-Tyne.
East Midlands: B. Gale, "Parkdale," Boulton Lane, Alvaston, Derby.
West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth: J. J. McClelland, 122, Wellington Road, Bilston, Staffs.
Middlesbrough: D. Anderson, 147, Stockton Street, Middlesbrough.
Preston: P. Leyland, 6, Ashley Terrace, Farington, Lancs.
Lincoln: E. R. Walter, M.Sc., The Technical College, Lincoln.
Burnley: W. Haworth, 72, Branch Road, Burnley, Lancs.
Falkirk: H. McNair, "Braewick," Larbert Road, Bonnybridge, Scotland.

National Ironfounding Employers' Association

President: J. Smith, Smith & Company (South Shields), Limited, Nile Street, South Shields.
Secretary: Harold G. Judd, C.B.E., 8, Frederick's Place, E.C.2.

The Institute of Vitreous Enamellers

President: Dr. J. W. Mellor, F.R.S., Sandon House, Regent Street, Stoke-on-Trent.
Chairman: W. H. Whittle, W. H. Whittle, Limited, Eccles, near Manchester.
Hon. Secretary: Miss E. Christine Elliot, 49, Wellington Street, Strand, London, W.C.2.

Foundry Trades' Equipment and Supplies Association

President: G. T. Lunt, "Briardene," Newbridge Avenue, Wolverhampton.
Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association

President: W. E. Clement, Morfa Foundry, New Dock, Llanelly.
Secretariat: 2, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION
The Registered Office and Laboratories of the B.C.I.R.A. are:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone: Central 1885. *Telegrams: CIRA*
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk
Telephone: 332

Contents

	PAGE
Industry and Patents	393
The Test-Bar Problem	393
Catalogues Received	394
District Presidents.—No. 4	394
The Public Works Exhibition	394
Random Shots	394
Ni-Hard	395
Ingot Mould Practice	397
A Simple Cupola Blast Volume Gauge	398
The Scrap Position	398
Notes on the Production of Cupola Malleable Castings	399
Publication Received	400
Welfare Work in Relation to Foundries	401
Leaves from a Foundryman's Notebook	404
Giant Melting Plant	404
This Week's News in Brief	406
Trade Talk	406
Obituary	406
Personal	406
New Company	406
Forthcoming Events	406
Raw Material Markets	408
Contracts Open	408

Industry and Patents

It is apparent that industry pursues no common policy towards the inventor and his patents. Some take every step possible to invalidate the claim, and thus throw the entire issue into the public melting pot. In general, such sections of industry thereby affected are not too prosperous. Other sections take steps to reinforce the inventor and his patent, believing that anything they pay by way of licence can easily be passed on to the public. By the intelligent use of the patent law, better conditions can often be established in the home and general international market, because the existence of a patent is a bond between its manufacturers in the various countries and, moreover, can effectually stop indiscriminate competition at its source. In the metal and alloy industry, generally speaking, there is usually an attempt made to invalidate any new patent covering composition and subsequent treatment. "Success" in the technical field has on many occasions been achieved, but it is perfectly obvious from an examination of subsequent events that the competition resulting from putting the "invention" into the open market has robbed the "inventor" and all those firms manufacturing the "invention" of any material profits. Old-established metallurgical firms, seeing a freshly-disclosed patent covering a certain composition, can often turn up their research and experimental records and prove that not only have they made such an alloy, but a small quantity has been sold. This is quite sufficient to annul a patent, but by doing so the work of the "patentee" and the original experimenter passes into the *domaine publique*, whereas, by keeping the matter out of Court, the "patent" situation can be reinforced and money accumulated to finance further research.

The mental attitude assumed by firms and persons working an unprotected process, when they see this covered by a patent, is usually of a pugnacious character. The "inventor" is regarded as having filched their idea, and has made matters worse by seeking the protection of the Patent Office. We suggest that an opportunity is afforded under these conditions for co-operation with a view to getting some real reward for a process which should obviously have been patented, because the only alternative is to give to the public, both at home and abroad, full permission to enter the market at unrestricted price levels. The only danger of this process is the formation of rings, which may sell their goods at too high a price, but experience shows that such a state of affairs does not last long. We are of opinion that the leading employers' federations are too prone to forget the commercial importance of patents until one appears which, directly or indirectly, affects their major activities, when it either cements or disintegrates the work of years.

The Test-Bar Problem

Anything that Mr. John Shaw says about the question of test-bars and specifications is entitled to our respectful consideration, especially in relation to national specifications, for in so far as anyone may be regarded as the original author of 321/1928, that person is Mr. Shaw. We therefore had great pleasure in publishing his contribution on physical tests for cast iron in our last issue. It is difficult to say much officially, without violating the necessarily confidential nature of committee work, before that work is completed, but it can be taken for granted that the industry will have ample opportunity of considering any proposals made.

Actually, the first point raised by Mr. Shaw, as to whether the new specification will apply generally to any castings or whether it will apply to those types specified in it, is one very much in the mind of the committee concerned, and its importance is fully realised. It is also very clearly understood that the casting section to which a given test-bar corresponds has to be considered and that the present basis of 321/1928 requires modification. We think few will disagree with the suggestion that in no case should the test-bar as cast be less in diameter or cross-section than the average cross-section of the casting it represents. At the same time, it must be realised that even the largest bar now used, awkward as it is to test, can only on this principle cover castings of comparatively small cross-sections; compared, we mean, with cross-sections that are cast and used every day. However, there is some consolation to be derived from the fact that the ordinary criteria of mechanical strength are seldom required for castings of really heavy section. Not only has the relationship of test-bar to section of casting to be considered, but also the consequential changes required if the test-bar sizes are modified in any way. As far as the influence of change of structure goes in the interior of heavy sections, this change is dependent on the nature and size of the graphite. If the test-bar size is related to section, there should be a parallel change in each provided the metal is the same and cast at the same time.

(Concluded on page 394.)

Catalogues Received

Gas Machines. The Incandescent Heat Company, Limited, of Cornwall Road, Smethwick, Birmingham, have used an eight-page brochure to describe a very neat design of automatic gas machine. When we throw our minds back to the days of the old type of gas producer, with its false bars, its sulphurous atmosphere, its slow response to the undoubted skill of the gas-maker, and compare it with this movable, non-clinkering, completely gasifying, entirely automatic unit, capable of operating furnaces from 100 to 1,600 deg. C., we are indeed amazed at the progress which has been achieved. Digressing, we are also impressed by the fact that the foundry industry in general has so ignored the undoubtedly great potentialities of producer gas as a heating medium. This causes us to suggest that this booklet is well worth while studying by most foundry executives. Small portable gas producers could usefully be used for core and mould drying, steel and malleable annealing, and the melting of ferrous and non-ferrous alloys.

Industrial Lighting. The major part of the illustrations used in a new brochure issued by the General Electric Company, Magnet House, Kingsway, London, W.C.2—entitled "The New Light of Industry"—is devoted to foundry practice. It appears that by using Osira electric-discharge lamps for general lighting, which give blue-green-yellow rays, the interior of complex sand moulds can easily be seen, and the use of a portable internal light entirely eliminated. This question of foundry lighting has recently been dealt with in our columns.

Steel Castings and Forgings. Perhaps preparatory to reopening the Darlington Forge, Limited, Darlington (subsidiary of the English Steel Corporation), have issued a very interesting little brochure, which illustrates and describes some of the finest engineering jobs turned out in Great Britain, such as the stern-frame casting for the "Queen Mary," the rudder-frame forging for the "Empress of Britain," and a main bearing, weighing 300 tons, for the Sydney Harbour Bridge.

Smith's Hearths and Blowing Fans. In their catalogue V 97, Messrs. James Keith & Blackman Company, Limited, 27, Farringdon Avenue, London, E.C.4, illustrate and describe a range of fans destined to work under continuous service conditions for the supply of air at moderately high pressures of 4-in. water gauge up to 20-in. w.g. (1 lb. per sq. in.). For our readers page 115 is the most interesting, as the question of smoke removal from shops is introduced.

Pneumatic Conveyance Unit. A three-page broadsheet received from Messrs. Davidson & Company, Limited, Belfast, Northern Ireland, introduces the subject of the conveyance of granular materials pneumatically. Whether foundry sand is, or could be, included we are unaware. It should, however, be worth while for foundrymen to read the available literature on this subject. The publication is numbered 8F186.

Publication Received

Industrial Electric Heating. Vol. 1. By Prof. Dr.-Ing. Knoops, Dipl.-Ing. Masukowitz and with the collaboration of the [German] electric-furnace industry. Published by Verlag Arbeitsgemeinschaft zur Förderung der Elektrowirtschaft A.F.E., Berlin, W.35, Buchenstrasse 5. Gratis. This is an extremely interesting piece of co-operative publicity work and takes the reader right across industry, whilst pausing to make comparisons with the older types of furnaces. This, as would be expected from its country of origin, is set out very logically. It runs to 64 pages and is well illustrated and clearly printed.

District Presidents.—No. 4

FALKIRK SECTION OF THE INSTITUTE OF BRITISH FOUNDRYMEN

MR. J. D. SMITH, the President of the Falkirk section of the Institute of British Foundrymen, served an apprenticeship as a patternmaker and was employed in the earlier stages of his career by several well-known firms in and around the Falkirk district. After an interval of some year spent in England, Mr. Smith returned to Falkirk in 1913, and joined the staff of Messrs. Watson, Gow & Company, Limited, as foreman

MR. J. D. SMITH

patternmaker, eventually being appointed foundry foreman, assistant works manager and finally works manager. In 1929 the firm was taken over by Grangemouth Iron Company, Limited, Grange Foundry, Falkirk, and since then Mr. Smith has been in charge of the light castings foundry of both firms.

The Public Works Exhibition

This exhibition, which was recently held at the Agricultural Hall, Islington, London, was unquestionably amongst the most interesting ever staged from the foundry point of view. The majority of the exhibitors are either foundry owners or important buyers of castings. Moreover, they were not all of the heavy engineering type, as amongst the lighter varieties there were the manufacturers of road sets, some of which were vitreous enamelled in brilliant colours for the making of Belisha crossings and the like; finger-posts and other lettered castings, manhole covers of improved design. Sand-spun pipes, crushers, screens, some of which are equally applicable to the foundry, conveyors of various types give to the exhibition a real "foundry" flavour.

ACCORDING to particulars collected from 146 local authorities by the Ministry of Labour, the estimated cost of buildings for which plans were passed in the September quarter was £27,586,100, or 25.4 per cent. more than in the corresponding quarter of last year. Of this total £18,352,800 was on account of dwelling houses, as compared with £15,449,200 in the September quarter of 1934.

Random Shots

The word "lamb" seems peculiarly harmless, a word of spring meadows and absurd frolicking, coloured by the memory of the gentle and whimsical essayist, Charles Lamb. Men of letters, as a whole, are given to internecine and guerilla warfare of a super-Abyssinian type. Lamb, almost alone among them, was generally beloved. The best of the old English inns include many "Lambs," and occasionally the "Lamb and Key." The name is usually a sign that a monastery or religious building stood on the site, and the inn itself is a survival of the ancient guest house, where wayfarers rested. The Lamb was the Paschal Lamb, and the Key St. Peter's Key. These centuries-old inns still stand, symbols of ancient peace and serenity. There is one in Burford . . .

* * *

One would say, then, that the word "lamb" is unlikely to offend the most susceptible of philologists, the most irate pursuers of the *double entente*. Yet it seems that to Mohammedans the word is as a red flag to, as the saying goes, a bull. The brand name, "The Lamb and Flag," admirable though it seems to occidental ears, is unacceptable to the Mohammedans, and so the "Lamb and Flag" of England becomes "The Pelican and Flag," the "Flamingo and Flag," the "Platypus and Flag," anything but the "— and Flag," as it sails down the Suez Canal.

* * *

It is evident that the way of the brand-name deviser is hard. When the vast mass of human prejudices are considered, it seems impossible that any name would be universally accepted. For instance, the brand name "Royal" or "Regal," which would be so popular in the British Empire, would be less popular probably in the U.S.S.R. There, one imagines, such a brand name as the "King of Hearts" would have to become the "Commissar of Hearts" or the "Comrade ('Tovaritch' to those who have seen the play running in London) of Communal Farming."

* * *

But why only brand names? Has the theatrical profession realised the danger of local prejudice? The manager who intends to stage "The Merchant of Venice" in Addis Ababa had better change the title to "The Merchant of Geneva." The author's name—Shakespeare—seems appropriate enough, but in view of the attempts at modernising the Abyssinian soldiery, perhaps Shake-machinegun would be a more tactful name.

* * *

Certain London cinemas now open at 10 a.m. "Marksman" can imagine the following conversation on the night shift:—"What are you doing this morning?" "Oh, I think I'll go to the pictures. The Superbia opens at 10." "Well, I'm going to bed. I had a late morning yesterday, and late hours don't suit me."

MARKSMAN.

The Test-Bar Problem

(*Concluded from page* 393.)

The points raised by Mr. Shaw concern the basis of testing to be adopted even more than the precise qualities to be covered by the new specification, and this raises two points with which everyone concerned will be in agreement. The first is that the basis of testing must be the same in all national specifications, and, secondly, that if the present basis of 321 needs modification, this should be done before the new specification is completed. Had, in fact, the new basis of testing been available, the new specification would in all probability have been formulated before.

Ni-Hard*

AN ALLOYED WHITE CAST IRON

Introduction

The essential difference between the two common engineering materials, cast iron and steel, lies in the greater amount of carbon which is present in the former. The limiting figure for carbon between the two types of metal is not very clearly defined, especially in these days of alloy irons and steels; but for most practical purposes it may be taken as about 1.7 per cent. The distinguishing characteristics of cast iron must be attributed to the carbon in excess of that figure.

This excess carbon occurs in either of two forms: free, as graphite, giving grey cast iron, or as iron carbide, the predominant factor in white cast iron. The form in which the carbon occurs in a casting is determined primarily by composition, but the cooling rate of the metal from the molten state has also a very important influence. Various elements, apart from carbon, also occur in cast iron, either as so-called impurities reduced with the iron in the blast furnace, or as intentional alloy additions, and each of these has its own individual influence in

FIG. 1.—MICROSTRUCTURE OF CHILL IN UNALLOYED CASTING. GENERAL VIEW. × 500.

tending to make the casting more grey or more white under a given set of conditions. Of the elements normally present, silicon has a strong greying effect, whilst manganese, sulphur and, to a smaller extent, phosphorus, all have the opposite influence. Among the more important metals added intentionally as alloys, nickel has a graphitising influence, while chromium assists in the retention of white iron. The influences of the various elements are, of course, balanced to some extent, occurring as they do simultaneously in the same metal, and the ultimate condition of the casting is determined by the total effect of the various elements present. In cast-iron practice, silicon has perhaps the predominant effect and is generally regarded as the controlling element. Irons with low silicon are usually white and, conversely, those with high silicon are usually grey.

The influence of cooling rate is important. Rapid cooling leads to the retention of the iron in the white condition, whilst slow cooling gives soft grey castings. It is on this account that with compositions of iron normally used for engineering castings there is a tendency to the formation of white or chilled spots in such quickly-cooled parts as thin sections, corners and edges. Much has been said elsewhere† concerning the variation in structure which is liable to be found in a casting of varying section, and the influence of nickel in equalising this structure, by eliminating chill and at the same time densening the thick sections and masses, is now widely appreciated in industry.

On the other hand, the tendency of an iron to chill as a result of quick cooling is often put to a useful purpose in engineering practice as, for example, when castings are required in which a hard-wearing face is needed on a casting which is otherwise strong and machinable. This result is obtained by casting the iron against heavy blocks of metal which, by the rapid extraction of heat from the casting, cause quick cooling with subsequent chilling of the iron and the production of a hard chilled face. Castings with this type of structure are termed chilled-iron castings.

Hard Cast Irons

The method of hardening castings by a heat-treatment consisting of quenching and tempering, similar to that used in the case of the steels, has been developed during the past few years, as the result of the facilitating influence of alloy additions, especially of nickel, and is now a recognised procedure in engineering production. Hardness in this case, however, is attained by modifying the matrix of the metal, without necessarily modifying the form or condition of the excess carbon present.

It is seen, therefore, that in the cast irons there are two distinct methods available for achieving hardness, one increasing the proportion of combined carbon by control of composition or by chilling and the other hardening the matrix of the metal by heat-treatment or alloying. Previously the highest hardnesses available in cast iron were attained in the white or chilled irons, the high hardness being due to the presence of the hard carbide constituent. To-day, however, a combination of the two above-mentioned methods has been developed. In this the massive carbides are maintained, and, by suitable alloying, the matrix of the iron is hardened. The hardness of a white-iron casting is the mean between the hardness of the matrix and of the hard carbides, so that hardening of the matrix will result in a marked improvement in the hardness of the casting as a whole. Such increases in hardness are achieved by suitable additions of nickel and chromium, with or without heat-treatment, and the resulting nickel-containing alloy chilled iron is commonly known as "Ni-Hard."

Chilled castings, however, are generally of massive form, and are rarely of such shape and dimensions that they can safely be submitted to any kind of heat-treatment embodying quenching and tempering. The use of sufficient alloys to ensure air-hardening, and therefore to obtain the desired result in the "as-cast" condition, offers an interesting and novel solution to the problem of increasing the hardness in white or chilled castings.

Effect of Nickel on Chill

As explained above, in order to obtain the maximum hardness, it is necessary to increase the hardness of the matrix to the fullest possible extent, and this is effected by adding sufficient nickel to render the matrix air-hardening. It has also been pointed out, however, that nickel tends to turn a "white iron" grey, thus, of course, reducing chill. It is clear, therefore, that the graphitising influence of nickel must be counteracted.

Various methods are available for maintaining chill depth when the nickel addition is made to a chilled casting or, alternatively, for maintaining a casting in the white condition, if its composition is such that it is white without chilling. The most usual of these is to add chromium together with the nickel, but other modifications in composition, such as reduction of silicon, increase of manganese, etc., also have their useful applications.

Chromium tends to stabilise the carbides, thus maintaining an iron in the white condition, and it has the direct effect of increasing the depth of chill in a chilled casting. Incidentally, the addition of chromium also adds slightly to the hardness of the carbide masses. As the chairman tends to enter into combination with the carbides, however, it has no very marked effect on the condition of the matrix of the metal. It thus becomes possible to balance the chill-reducing effect of nickel by means of chromium. Generally speaking, the proportion of chromium to nickel necessary to balance chill should be 1 to between 2½ and 4, depending on the composition of the base iron.

The hardness of the carbides in a white iron is generally given as about 700 Brinell, whilst that

FIG. 2.—MICROSTRUCTURE OF CHILL IN "NI-HARD." × 500. T.C., 2.75; NI, 4.5; CR, 0.8; MN, 0.4; SI, 0.5.

of the pearlitic matrix is generally of the order of 200 to 300. In "Ni-Hard," with an addition of about 4.5 per cent. of nickel and 1.5 per cent. of chromium, the matrix hardness is increased to between 500 and 700 Brinell, so that the hardness of the chilled face is itself increased from somewhere in the region of 500 to about 700 or 800. At the same time, the alloys refine and toughen both the chilled portion and the grey backing. These qualities have led to the extensive application of "Ni-Hard" in practice where a superior wearing quality material is required.

Manufacturers are generally well familiar with the compositions for their white or chilled castings necessary to give the best results under given conditions. Thus, if hardness is the prime consideration and strength of less importance, a high carbon content of 3.6 or over is selected. If, on the other hand, the castings are subject to shock, and maximum strength and toughness are required, then a low carbon is usually employed, and in the manufacture of certain

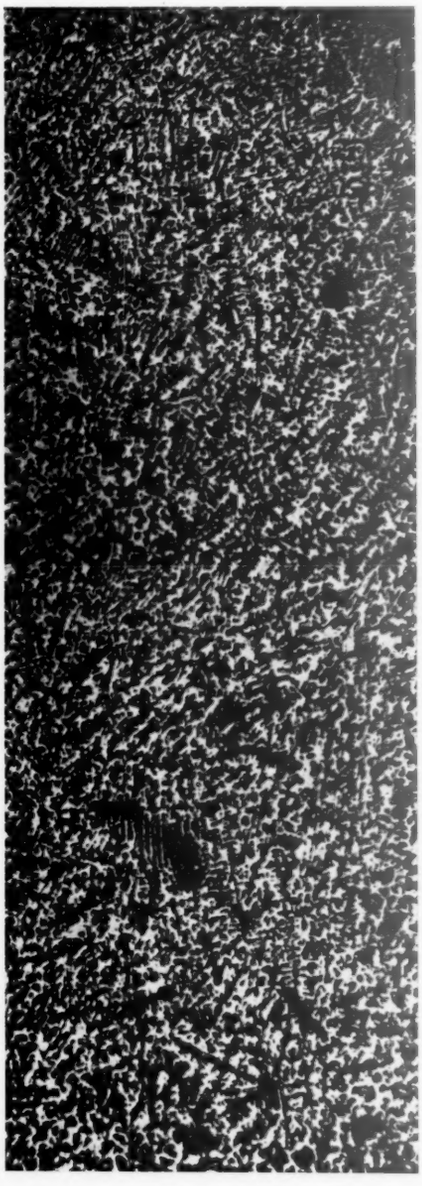
o 2

* Communicated by the Bureau of Information on Nickel. The manufacture of "Ni-Hard" is protected by British Patent No. 279,414.

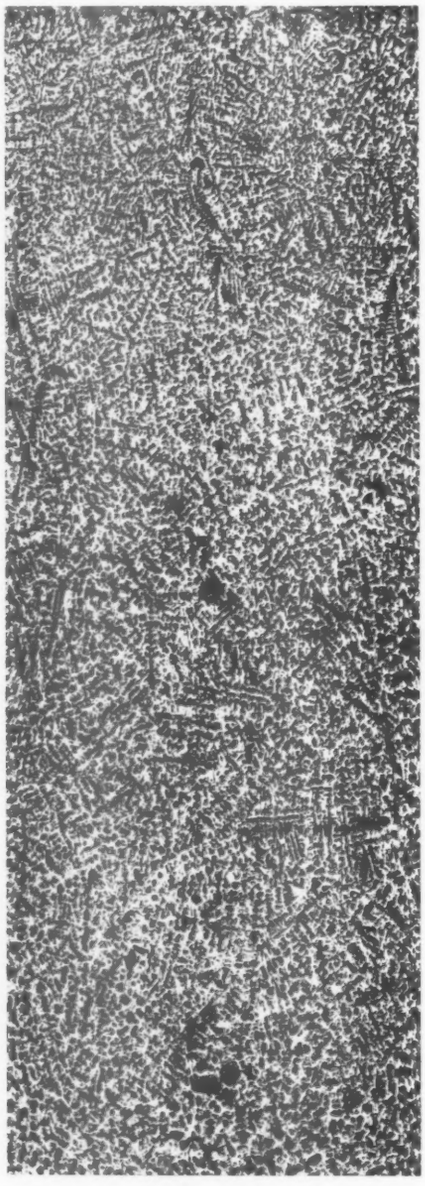
† B15 Publication, "Nickel Cast Iron To-day," issued by Mond Nickel Company, Limited.

chilled castings from the air furnace, the carbon may be as low as 2.5 per cent.

To obtain the best results from "Ni-Hard" careful control must be maintained over all the elements present in the iron. As a general rule, chromium, whilst giving hardness, tends to detract from the strength of the castings, and it has been found by experience that the best results are obtained when steps are taken to keep the chromium addition at the minimum possible. One of the most effective steps which can be taken in this way is that of reducing silicon, since a silicon reduction has the same effect of increasing chill as has a chromium addition, but without the deleterious effect of chromium on strength.



Unalloyed.



Ni, 3.5; Si, 1.5; Cr, 0.75.

FIGS. 3 AND 4.—GENERAL VIEW OF CHILL IN PLAIN IRON AND "NI-HARD" TO SHOW REFINING EFFECT OF THE ALLOY ADDITION. × 50.

Effect of Manganese

Another element of considerable interest in this connection is manganese. In considering the effect of manganese, however, the sulphur content must be borne in mind. If manganese is present in any small proportions, its inherent property of increasing chill will be rendered ineffective by the fact of its preferential combination with sulphur until all the latter has been absorbed. (It should be explained that in British practice a relatively high proportion of sulphur is frequently used in chilled castings, far in excess of the amount which can be neutralised by the manganese normally present.) Since sulphur itself is a powerful chilling agent —though it tends to render the castings brittle —the first effect of manganese additions may be to soften the chill and to reduce chill depth, simply by the removal of sulphur. Before any increase in chill depth is achieved, therefore, it may often be necessary to increase the manganese content to as much as 0.6 per cent. The usefulness of manganese is strictly limited, however, and in practice it is rarely safe to increase the content to more than 1.25 per cent.

Subject to these limitations, manganese definitely adds to the chill depth, and makes it possible to reduce the amount of chromium required, with the consequent advantage of a gain in strength.

Phosphorus is the only element commonly found in cast iron which has not been mentioned. It has relatively little effect on chill depth and tends to make cast iron brittle. For the latter reason alone phosphorus is generally kept to a low figure in chilled or white iron castings.

At this point mention might be made of molybdenum as another element which may usefully be added to alloyed chilled irons. The effect of molybdenum on chill depth is not clearly defined; it has, however, a certain refining and toughening effect so that in some classes of chilled castings, notable in the case of chilled rolls, ¼ to ½ per cent. of molybdenum finds a useful application.

Spread of Mottle

A factor of some importance in connection with chilled castings is that commonly known as the spread of mottle. Between the specified depth of clear chill and the grey backing in a chilled casting lies the mottled transition zone. It is well known that with certain compositions a sharply defined chill occurs and the transition zone is narrow. On the other hand, other compositions tend to give a wider and more dispersed mottle. In some applications, as, for example, in plough shares, the sharp demarcation between chill and grey is desirable, but in other cases, as in certain types of chilled roll, a wide spread of mottle is not considered objectionable.

Alloy additions in chilled castings may naturally have a pronounced effect on mottle. Chromium especially is found to cause spread of mottle, so that in certain castings such as rolls it may be found that with high proportions of chromium even in balance nickel-chromium compositions the mottle zone will spread almost from the surface of the roll to the core, fine particles of graphite being found near the surface in the chilled part, whilst silvery streaks of carbide tend to run back to the centre of the casting. This problem has been exhaustively studied* and it is now established that spread of mottle is liable to occur in "Ni-Hard" compositions in proportion to the chromium present.

The amount of chromium required to maintain depth of chill in "Ni-Hard" can, however, be substantially reduced and kept to a minimum by the manipulation of the composition generally. Thus, as already mentioned, chill depth can be increased by lowering silicon and also by increasing manganese so that to maintain maximum strength and freedom from spread of mottle the best results are usually obtained with minimum silicon, manganese raised to about 1.25 per cent. and chromium present in just sufficient quantities to give the desired depth of chill.

Composition of "Ni-Hard"

Enough has been said above to indicate that certain broad principles underlie the choice of alloy compositions for use in "Ni-Hard" castings. In the case of many applications unalloyed white irons of normal composition are already in use. In these cases nickel up to 4.5 per cent. is added to obtain the required hardness level whilst at the same time chromium, with or without modification of the silicon and manganese contents, is used to maintain the required depth of chill. This leads to compositions of the types indicated in Table I.

TABLE I.—*Typical "Ni-Hard" Compositions.*

	A.	B.	C.	D.
T.C.	3.0	2.8	3.6	3.6
Si	0.8	0.5	0.8	0.5
Mn	1.2	1.2	0.8	0.8
S	0.1	0.1	0.1	0.1
P	0.3	0.3	0.3	0.3
Ni	4.5	4.5	4.5	4.5
Cr	1.0	0.75	1.5	1.5
Mo	—	0.25	—	0.25

Type A is for light section chilled castings of maximum strength.
Type B is for heavy castings of maximum strength.
Type C is for light castings of maximum hardness.
Type D is for heavy castings of maximum hardness.

These compositions are submitted as giving the maximum hardness attainable in each type. Where easier machining properties are required and intermediate hardness levels are sufficient, a modified "Ni-Hard" composition may be adopted in which the nickel level is dropped to

* Griffiths, "Proc. Inst. of Brit. Foundrymen," FOUNDRY TRADE JOURNAL, April, 12, 1935.

about 3.0 to 3.5 and the chromium correspondingly lowered to the range of 0.5 to 1.0 per cent.

Properties of "Ni-Hard"

Table II shows some typical test results obtained with chilled unalloyed and "Ni-Hard" irons:—

TABLE II.—*Typical Results of Tests of Chilled Plain and "Ni-Hard" Irons.*

	Unalloyed iron.		"Ni-hard."	
	High carbon.	Low carbon.	High carbon.	Low carbon.
T.C.	3.50	2.75	3.50	2.75
Si	0.75	0.75	0.75	0.75
Ni	—	—	4.50	4.50
C	—	—	1.50	1.50
Brinell hardness of chilled surface	500	400	650—700	575
Shore hardness on chill face ..	70	55	90	78
Tensile strength in chilled section, tons per sq. in. ..	16—18	21—24	25—27	31—36
Tensile strength in grey core, tons per sq. in.	7—11	10—17.5	13—16	18—22

These test results show that for maximum hardness a high carbon level should be adopted and for maximum strength, a low carbon level. Hardness results obtained in practice show that, even in large castings, values as high as 90-95 Shore may readily be obtained, while figures up to 102 Shore have been recorded on test-pieces.

Although wear tests carried out under laboratory conditions often give results which are a little difficult to correlate with those results obtained in practice, it is of interest to note that such tests show that "Ni-Hard" has a life of from five to twelve times longer than is the case in plain chilled iron. Service records for "Ni-Hard" castings of all types have given ample evidence of the superiority of "Ni-Hard." For example, cement-mill rolls and liners in "Ni-Hard" have lasted 4,000 hrs., as against 600 to 700 hrs. for plain chilled iron, whilst coal-pulveriser hammers in "Ni-Hard" have been in operation during the grinding of 2,400 to 2,900 tons of coal, as against 400 to 600 tons with plain iron. Incidentally, it may be mentioned that in many applications "Ni-Hard" offers a better service than the more commonly-used alloy iron and steel when abrasion resistance alone has to be considered.

As would be expected from the high hardness figures obtained, "Ni-Hard" is not readily machinable. With the softer modified compositions, castings may be machined under more or less ordinary conditions, while with the new tungsten carbide tools, operating under modern conditions, chilled castings with a surface hardness as high as 80 or even 85 Shore, can be satisfactorily machined. In the case of many castings with the full "Ni-Hard" composition, however, it is found that for both roughing and finishing grinding is necessary.

Microstructure of "Ni-Hard"

As has been indicated, the essential feature of "Ni-Hard" is that the matrix of the iron in the white portion is rendered air-hardening, and therefore has a martensitic instead of the ordinary pearlitic structure. Typical microstructures showing the chill in unalloyed white iron and in "Ni-Hard" are illustrated in Figs. 1 and 2, in which the pearlitic and martensitic matrices are clearly shown between the carbide areas. A special feature of "Ni-Hard" compositions is the refining of the general structure, illustrated by Figs. 3 and 4, which compare the chill structure in a plain iron casting with the structure of "Ni-Hard" cast under similar conditions.

Applications

"Ni-Hard" may with advantage be substituted for plain iron in almost all applications where chilled or white iron castings are normally employed. Items of special interest are, of course, chilled rolls used for the hot- and cold-rolling of steel and non-ferrous alloys whilst those employed in other industries as, for example, paper making, rubber working, and in crushing and grinding applications of all types, such as cement mills, cereal grinding, etc., might be mentioned.

Extended life of other parts of crushing and grinding machinery may also be secured by the adoption of "Ni-Hard" compositions; ball mill balls and lining plates, jaws for jaw crushers, coal crushing and pulverising equipment, rabbles, doors and other general castings used in cement and mineral handling furnish notable examples. Other applications include pump bodies, impellers, pipes, elbows, etc., for use in connection with minerals, sand and ash. In machine shops and foundries, sand blast nozzles, sand impellers, rests and drums for centreless grinding machines and, indeed, all applications requiring tough, abrasion-resistant castings, give opportunities for the successful and economical use of "Ni-Hard."

Ingot Mould Practice

In connection with the Paper "Some Notes on Ingot Moulds," by DR. SWINDEN and MR. G. R. BOLSOVER, presented to the annual meeting of the Institute of British Foundrymen and published in these columns,* Messrs. Eisenwerk Sulzau-Werfen (R. & E. Weinberger), Vienna, wrote:—

In the production of ingot moulds for steelmaking, the important factors are not merely the conditions considered necessary to produce first-class grey-iron castings, but particularly the conditions of use of the moulds, the latter having the major effect on their life.

The influence of these conditions varies in every steelworks. Hence, comparison of the service given by moulds cannot be made simply by recording the lives obtained. To obtain useful comparative data, the lives of moulds of different origin in the same steelworks must be recorded.

The factors which are of importance as regards the life of ingot moulds are as follow:—(1) The selection of the raw materials for the manufacture of ingot moulds; (2) the method of making the foundry moulds in which the ingot moulds are made; (3) the type of furnace in which the metal is melted; (4) the quality of steel which is cast in the ingot moulds; (5) the manner in which this steel is poured into the moulds; (6) the treatment of the inner surface of the mould in the steelworks; (7) stripping time; (8) how the moulds are cooled afterwards; (9) bottom plates; (10) the requirements regarding surface of the steel ingot, and (11) the design of the moulds.

The following notes refer particularly to moulds for ingots of 4 tons weight. Points 1, 2 and 3 are discussed in detail, whereas the others are referred to more briefly, as the mould founder has no control over them, although he must consider them.

(1) The most important properties, which the ingot mould metal must have, are highest uniformity of structure, freedom from internal stresses and capacity of resistance to repeated thermal shock. Generally, hematite is regarded as the best raw material owing to its purity, as this ought to give the best guarantee of freedom from stresses and resistance to repeated heating and cooling. This is the case with certain exceptions. The experience of mould founders is that every hematite pig-iron is not equally suitable; although some hematites show good results, others are poorer. This might be due to the physical properties imparted to the pig-iron by the ore.

Very good results are obtained with charcoal pig-irons owing to their freedom from internal stresses and resistance to thermal shock.

* FOUNDRY TRADE JOURNAL, August 1, 1935, page 81, *et seq.*

The following notes refer to ingot moulds, made chiefly from charcoal pig-iron, as made at our works, "Konkordiahütte," Werfen, Salzburg, Austria. Tests were made with another charcoal pig-iron of a very similar analysis, which gave far poorer results. It seems, therefore, that Werfen charcoal pig-iron is particularly suitable for the manufacture of ingot moulds. We explain this by special properties of the ores, which are very poor and require much fuel for the smelting process. Hence, the iron contains a high percentage of carbon, between 4 and 4.7 per cent.

We consider that the chemical composition of moulds for four ton ingots should be as follows:—Total carbon, 3.90 to 4.10; silicon, 0.80 to 1.00; manganese, 0.60 to 0.90; phosphorus, 0.15 to 0.20 per cent.; and sulphur, as low as possible. When making moulds of cupola melted iron, we mix our iron with English West Coast hematite and our own runners, risers and wasters to obtain the desired silicon content.

(2) All ingot moulds were cast with the foundry moulds standing upright and the molten metal entering from the bottom.

(3) The moulds were cast from three different furnaces: small cupola, larger cupola and direct from the blast furnace. The records of a steelworks, which extended over several years, included 130,000 casts, *i.e.*, 7,000 casts in moulds made from the small cupola, 39,000 casts in moulds from the large cupola and 84,000 direct from the blast furnace. These showed that the lives of moulds made from the small cupola were on the average 2 per cent. lower than those from the large cupola, the latter being 20 per cent. lower than those direct from the blast furnace. In spite of these records, we may say that we had over 500 lives not only from the blast-furnace moulds, but also from cupola moulds. The records of three steelworks showed:—

Works A.—Average = 338.5 lives (33,193 casts).
Works B.—Average = 241 lives (56,182 casts).
Works C.—Average = 210 lives (129,985 casts).

All moulds which are made with our charcoal pig-iron show evenly-distributed graphite and fine-grained structure.

(6) The protection of the inner surface of the moulds has had a beneficial effect on mould life and has increased it at one works as much as 50 per cent.

(7) Stripping time influences mould life, inasmuch as when ingots are left too long in the moulds, the temperature of the mould not only rises but also fluctuates more considerably.

(8) The cooling of the moulds after removal of the ingots has a very great influence on mould life. The best method is to cool the moulds on grids, provided that the moulds are not too close together and that air can pass between

(9) From the records of one works, it appears that moulds which were always placed at the outer edges of the bottom plate had 20 per cent. greater life than those which were placed in the centre of the bottom plate.

Authors' Reply

Since the reading of the Paper, the authors have had very interesting correspondence with the proprietors of Eisenwerk Sulzau-Werfen (Messrs. R. & E. Weinberger), of Vienna, and this written contribution to the discussion is deeply appreciated. In the first place, the authors tender their sincere apologies and regrets that in their Paper the moulds which were reported upon and which had been supplied by this company are referred to as German moulds. The company have properly pointed out to us that these should have been referred to as Austrian moulds.

The analyses of the moulds used and reported upon by us, agree reasonably well with that stated in this contribution except that we found the manganese to be somewhat lower than Messrs. Weinberger consider to be the best. The interesting point is made however and supported

(*Concluded on page* 406)

A Simple Cupola Blast Volume Gauge*

By J. K. SMITHSON

The rate at which the blast is supplied to a cupola has a very great influence on the rate of melting, coke ratio, tapping temperature and general efficiency of the furnace as well as affecting to some extent the physical properties and soundness of the castings. It would therefore seem that a blast-volume indicator should be almost indispensable to successful cupola operation, yet it is remarkable to find that comparatively few cupolas are equipped with such an instrument.

A Pitot tube in conjunction with a differential pressure gauge provides the most convenient means of measuring the speed of air currents, and it should be easily within the resources of any foundry to construct and fit the gauge which it is the purpose of this Paper to describe. Essentially the Pitot tube consists of two parts, the simplest form being shown in Fig. 1. The bent tube A, which points upstream determines the sum of the velocity pressure and the static pressure, whilst the straight tube B measures the static pressure. When the Pitot tube is connected to a manometer as shown in the diagram a difference of pressure is noted. This difference of pressure, P, is due to, and a measure of, the velocity of the current of air, being proportional to V^2 where V is the velocity of the current, *i.e.*, $P \propto V^2$. The velocity of the current is given by the formula:—V (feet per minute) = $1{,}713\sqrt{P}$. The velocity of the air current in the blast main being known, the volume can readily be calculated by reference to the cross-sectional area of the main.

The simple form of Pitot tube already described is open to the objection that secondary velocity effects may give rise to error in the determination of the static pressure and the use of the N.P.L. pattern Pitot tube shown in Fig. 2 is recommended. This consists of two concentric tubes, the inner one having an open end determines the sum of the dynamic pressure and the static pressure, whilst the outer one which has a closed end with a series of small holes drilled at right angles determines the static pressure more accurately than the straight tube shown in Fig. 1. The velocity of a current of air in a pipe is not the same over the entire cross-section, being greater at the centre than near the walls.

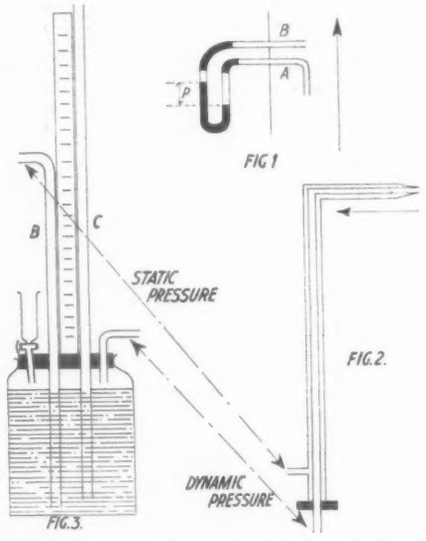
The mean velocity is generally found in a position about one-sixth to one-third of the diameter from the walls, and the Pitot tube should be fixed in this position for use, care being taken that it points upstream exactly parallel to the flow of air. It should also be placed if at all possible not less than about 6 ft. from any bend or constriction in the main, as changes in section or direction give rise to turbulence effects which will upset the accuracy of the readings.

The lay-out of cupola-blast mains does not always provide a sufficient length of straight tube of even diameter to permit the use of the Pitot tube under the ideal conditions indicated above. Where conditions are not ideal the instrument is still of considerable value, as, although the readings obtained when converted to cubic feet per minute may not be strictly accurate, nevertheless they are comparative and sufficiently accurate for checking the output of a cupola fan and maintaining the correct rate of delivery once this has been determined by experiment.

Fig. 3 shows the type of gauge which the author has constructed in preference to the ordinary U-gauge. This indicates the total pressure as well as the velocity pressure, and serves the dual purpose of an ordinary pressure gauge and a volume gauge. It consists of a wide-necked bottle whose diameter bears a large ratio to the diameter of the tubes B and C, so that the rise and fall of the liquid in the tubes produces only a negligible alteration in the level of the liquid in the bottle. The stopcock funnel is added for convenience in adding fresh water to replace loss by evaporation. In most cases the velocity in the blast main will be sufficient to give a large reading, say 6 to 8 in. in tube B. Where, owing to the large size of main in relation to the amount of air passing, the readings are small they can be magnified by bending tube B over at a suitable angle.

It will save much time in calculation to construct a graph from which the corresponding volume for various values of P may be read. This is a quadratic curve so several values of P and V should be calculated and plotted; a straight line joining the points for a large and small value will not be accurate for intermediate values.

A little experience with this gauge will demonstrate that the blast-pressure readings as indicated in tube C bear no relation whatever to the volume of blast supplied to the cupola. A rise in the total pressure as shown by the level in tube C is frequently indicative of some obstruction to the free passage of the blast, such as blocked tuyeres or bridging, and will be found to be accompanied by a decrease in the volume of blast passing as shown by reading tube B. On the other hand it will be found when blowing down, unless the fan speed is reduced, the volume increases as the level of the materials in the furnace descends, whilst the total pressure decreases.



It is not within the scope of this Paper to deal with the evils of incorrect cupola blowing, the intention having been merely to describe a simple means of bringing one of the most important variables in cupola practice within approximate quantitative control. The means described are by no means new or original, though the author's experience leads him to believe that the Pitot tube is not as well known in foundry circles as it deserves to be.

* A Short Paper presented to the Middlesbrough Branch of the Institute of British Foundrymen, Mr. A. Scholes presiding.

Steel for the Motor Industry

Tunstall Steels, Limited, has been formed to manufacture steel products for the motor trade, with offices at Lombard House, Birmingham. Mr. E. L. Payton, deputy chairman of the Austin Motor Company, stated on Monday that the capital put up was nearly £700,000. It was intended to make specialised steel sheets, stampings, and drop forgings, in accordance with the latest American practice. Ninety per cent. of the plant would be bought and produced in this country. He added that a 50-acre site at Wolverhampton had been acquired, but it did not necessarily follow that the works would be located there.

The Scrap Position

BY "ONLOOKER."

The improvement in the quotations for virgin metals has given consumers the satisfaction of seeing the margin between scrap and new metal widen to some extent, a change for the better which has been overdue for a long time past. The scrap dealers themselves have realised that in trying to sell their products at prices showing but little saving on the cost of new copper and spelter they were up against a factor likely to check business, and this widening of the margin is therefore welcomed by them as well. From the merchant's point of view however the trouble is, that during the period of low metal prices the foundries have grown accustomed to the use of virgin material and to win back the lost ground is not going to be easy, for there is much to be said in favour of making up heats from new metals and process scrap, and everybody knows the drawbacks attaching to the use of old metal.

It is in this question of quality that much of the trouble lies, for unfortunately during the past two or three years consumers have had much ground for complaint especially in regard to imported material. The narrow margin of profit accruing to dealers in scrap metals when the prices of virgin metals are unduly low has doubtless led to the rigidity of inspection being relaxed, and in consequence complaints have been numerous. No right minded buyer expects that he is going to receive the equivalent of virgin material at a scrap metal price, but he does count on getting what he is asked to pay for! Probably only about 10 per cent. of old metal coming into the market is really straightforward stuff ready for delivery to the foundry without any kind of inspection, the remainder requiring scrutiny and probably sorting. How often one hears the phrase, "a good parcel spoilt" applied to a consignment of scrap, the trouble arising often enough through careless putting up and perhaps the inclusion of mill sweepings.

As the middleman in the scrap metal trade, the merchant has often enough to educate his customers by persuading them that a certain type of material is suitable for their work, but he has also to endeavour to persuade suppliers that the presence of foreign matter will render a parcel useless. Sorting requires space, equipment and labour, all of which cost money, and careful grading by segregation in bins at the place of origin saves much expense and trouble later on. Most merchants covering a large annual turnover in old metals face up to the necessity of sorting and grading incoming parcels, but some houses endeavour to conduct their business with no other facility save that offered by hired space at a railway warehouse, and in such circumstances a contaminated parcel is obviously a serious embarrassment.

More than ever to-day buyers of old metal wish for quality, and they would rather pay more for this assurance than be faced with all the trouble and annoyance arising when a consignment of "cheap and nasty" material is delivered. Foundry managers and their foremen are usually vigilance personified and their instinct for bad stuff is something like a sixth sense, but obviously there may be occasions when with the "poison" well hidden a faulty parcel is accepted, and the first sign of trouble comes when the castings are being machined. That is the sort of thing which gives scrap a bad name, and the dealer in old metal who wishes to build up and maintain a good turnover should put quality beyond everything. The rising tide of trade and public works on a big scale cannot fail to bring out more and more old metal as the months go on. For the scrap dealer it will be a great opportunity, but let him watch quality!

Notes on the Production of Cupola Malleable Castings*

By F. B. RIGGAN, Birmingham, Ala., U.S.A.

Since the beginning of malleable cast-iron production in the United States, a variety of furnaces has been used for melting the iron. Probably the earliest furnace used was the crucible, where the iron was taken out in the liquid form without refining. The final analysis was practically identical with that of the mixture going in the furnace. This method, although ideal from a metallurgical standpoint, did not fit into the changing conditions of mass production and competitive costs.

To-day, probably 90 per cent. of the total tonnage of malleable cast iron produced is melted in the air furnace, open hearth, electric furnace, or one of the duplexing processes. A great portion of the remaining tonnage is melted in cupolas by those plants where it is desirable to maintain continuous operation.

When the writer was asked to comment on some of the practical aspects of the manufacture of cupola malleable at his plant, his attention was called to the lack of literature on this subject. A survey of published literature on cupola malleable revealed the fact that, with the exception of a few very general articles in this country in the "Foundry" and of a brief mention in the symposium on Malleable Cast Iron,[1] no modern data were available.

In 1926 twenty-six German foundries sent in data on cupola malleable to the Kaiser Wilhelm Institute for Iron Research, at Düsseldorf, at the suggestion of the German Engineering Society.[2] These data, which covered malleable with 20.5 tons per sq. in. tensile and 3.5 per cent. elongation, are still quoted year after year, for the simple reason that information such as that shown above is all that is available.

The situation in regard to information published and contained in various handbooks in the malleable industry has been similar to that in the grey-iron industry. For many years handbooks on mechanical engineering gave the strength of grey-iron castings at very low figures, sometimes as low as 7 tons per sq. in., although castings were actually being sold on a minimum basis of 26.7 tons per sq. in.

It is significant that such technical and metallurgical advancement made the past few years, with the many refinements in cupola operation and closer laboratory control methods, has resulted in cupola malleable iron much higher in quality than that obtained several years ago. The writer believes that a brief Paper depicting some of the practical aspects governing the routine practices and observations of results covering many thousand test-bars and analyses may be of some value as a contribution to the published information on cupola malleable cast iron.

Advantages and Disadvantages

Although having somewhat higher carbon and lower test-bar strength than the normal air-furnace product, cupola malleable iron has many qualities that fit it peculiarly to the continuous production of light castings. The high fluidity of cupola iron is of great importance in running small thin castings, as will be discussed later in this Paper. The advantage of low shrinkage with reference to sound castings is obvious when dealing with castings subject to internal pressure. The accelerated cooling of the castings from liquid metal in the mould to black heat is advantageous in respect to primary graphite, grain size and annealing. In the plant with which the writer is connected the interval of time between the pouring of the mould and shake-out is very important and carefully regulated. A yield point of about 70 per cent. of its tensile strength makes for greater rigidity and bursting strength.

Mixtures and Raw Material

Steel scrap is obtained from local structural and fabricating plants and is bought according to the following specifications:—

Structural-steel scrap.—Size 24 in. length maximum; ¼ in thickness minimum; 100 lbs. maximum weight of single piece, and to be free from wrought iron.

When loads of this steel arrive in the yard they are inspected by the metallurgical department. The lorry is not moved until the unloading foreman has an order from the laboratory consigning this car to its particular bin. Fig. 1

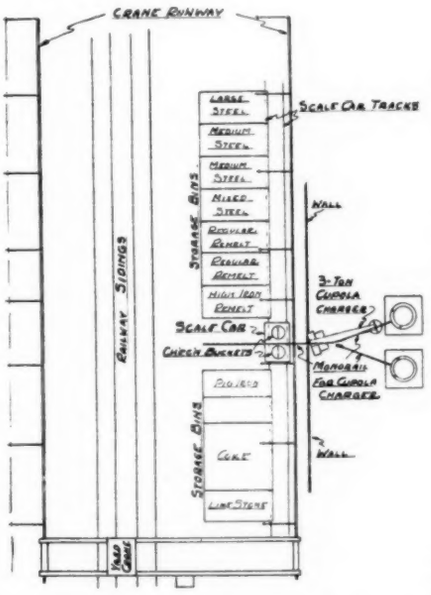


FIG. 1.—LAY-OUT OF STORAGE BINS AND CUPOLA-CHARGING ARRANGEMENTS.

shows the arrangement of the storage bins and cupola-charging lay-out. Consignments containing small pieces, such as punchings or clippings, are sent to the steelfoundry for use in the electric furnace. Those containing any wrought iron, or pieces thicker than 1 in., are sent to the grey-iron foundry bins. That steel accepted as suitable for melting stock in the malleable cupolas is unloaded by means of an overhead magnet crane, into a series of four large sloping bins. Here a further grading takes place. In one bin the large new stock is segregated so far as this can be done conveniently with the magnet.

Two bins hold the medium, or most satisfactory, sized pieces, and the fourth bin holds the scrap that is so thoroughly mixed that no further separation is possible with the magnet. The ideal size, as related to the charge and mechanical equipment, would be a 4-in. angle, ½ in. thick and 18 in. long. Stock of this size is most suitable for fast, hot melting. Steel scrap usually constitutes a considerable portion of our total charge. All remelt is cleaned and freed from sand. All castings which are scrapped subsequent to annealing operation are melted in the grey-iron mixtures. A local low-phosphorus pig is used in varying amounts for the purpose of holding the carbon in the charge constant. Experience has shown that this can be done more uniformly by varying the amount of pig-iron in the charge than by varying the steel. This pig analysis is:—Si, 2.00; Mn, 1.50; S, 0.04; P, 0.40, and C, 4.25 per cent. The above iron charge is considered ideal for mechanical charging, since there is a minimum spread in silicon analysis of the components of the charge.

Coke

Of all raw materials entering the cupola, coke is considered most important. Yet, peculiarly, the yard stick for measuring the desired quality in the material is very crude. Although there is a standard set up of running rather complete analysis on this material, including shatter, combustibility, ash, microscopic examination of cell structure, etc., the most dependable check, so far as performance is concerned, is controlling the unloading of the trucks. Large-sized, grey-coloured, dense structure with few "lady fingers," black heads or fines, ensure best performance if the chemical analysis be within range.

Until four or five years ago, it was felt that there should be at least a portion of the coke charge, consisting of petroleum or pitch coke, in order to get consistent high temperatures. Since then, it has been possible to standardise on a local by-product coke made from local coal seams. Coke from a particular mixture of this coal has the following analysis:—Volatile matter, 40 to 1.00 per cent.; ash, 9.00 to 9.60 per cent.; fixed carbon, 89.75 to 90.50 per cent.; sulphur, 0.60 to 0.63 per cent.; B.T.U., 13,000 to 13,400.

The relatively slow-burning coke seems to give best performance in this particular operation. Incidentally, some of the coke that worked less satisfactorily analysed very closely to the above specifications. In general, the coke that gave trouble would vary from the above averages, as follows:—Volatile, higher; ash, lower; carbon, same; sulphur, higher. In this connection it must be remembered that these are personal tests for domestic highly-specialised product, and it should not be inferred that cokes varying from above are not good foundry coke.

Mixtures

The usual mixture consists mostly of remelt, steel scrap and pig-iron—the proportions of these are regulated in accordance with the amount of remelt available and other variable conditions. The analysis of the castings is controlled by the addition of proper amounts of silicon briquettes or manganese briquettes.

Briquettes

Silicon and manganese are added to the charge in the form of briquettes. By using the silicon briquette it was possible to cut the silicon entering the charge 5 per cent., due to the protective nature of the binder in preventing oxidation of the silicon. Not the least of the benefits derived from the use of these briquettes is that of being able to count the briquettes on each charge, rather than depend on the accuracy of small weighing devices kept around the charging platform. To prevent any possibility of briquettes from one charge falling in those of the preceding charge, due to charges hanging up in the buckets, the briquettes are placed in the bottom of each succeeding coke bucket. This places the briquettes on top of their proper charges.

Charging

The charging buckets are placed on a multiple beam scale car. Each beam is numbered corresponding to a particular iron material bin. The first four beams are for steel scrap as shown in

* A Paper read before the Toronto Meeting of the American Foundrymen's Association. The Author is Metallurgist to the Stockham Pipe & Fittings Company.

1 "Symposium on Malleable Iron Castings," 1931. Published jointly by the American Foundrymen's Association and the American Society for Testing Materials.

2 Dr. Kalpers, FOUNDRY TRADE JOURNAL, April 4, 1929.

Fig. 1. As may be noted in Fig. 1, the first beam is for large steel, the next two beams are for medium sized pieces, and the fourth beam is for mixed steel scrap. The next three bins are reserved for remelt. Return sprues and risers from the heavy floors are kept separate from the regular remelt. So far as possible, each day's remelt is kept in a separate bin and used completely before changing over to that made the following day. Bin 8 is used for pig-iron. A charging bucket of conventional type ensures accurate distribution of material in the cupola.

Cupola Operation

In starting the cupola about two-thirds of the bed coke is burned by natural draft to a good cherry red. By proper manipulation of the tuyere doors this burning through can be done very uniformly. The last third of the coke is then added, making a total depth of bed of 50 in. Four or five charges are lowered into the cupola and the blower is started immediately. Nine minutes is the usual time for the first iron at the tap hole. While this iron is melting, the number of charges in the cupola is increased to nine, and the stock is usually held at this level for the remainder of the heat.

For the size of cupola used a variable speed blower is usually set at a definite figure to give the required melting rate and the desired pressure is obtained by regulating the height of stock in the cupoa. On these front slagging cupolas, the iron runs continuously into large teapot type mixing ladles. The slag level inside the cupola can be varied as desired by raising or lowering the height of the over-flow slag notch. When it is desired, as much as two inches of iron can be held in the cupola by raising or lowering the dam back of the slag cut-off. Giolitti[3] in a recent comment on cupolas in general makes the statement that the syphon shaped, tap hole brick device is the most important cupola development in twenty years. In the writer's opinion, the front slagging device, located outside the cupola has additional advantages over the tap hole brick. In the usual routine practice, an additional control on carbon is found by proper manipulation of this slag cut-off spout. The molten slag runs from this cut-off down a covered trough into large iron pots, which are placed between two cupolas, on a narrow gauge track.

The resulting slag is derived as follows:—

Per cent. slag	From
28.0	coke ash
40.0	lime rock
18.0	cupola lining
5.5	iron and manganese
3.0	briquette binder
5.5	silicon and other losses

The slag weight is approximately 6½ per cent. of the total iron charged.

Fused soda-ash added to the back of the tilting fore-hearth in the amount of approximately six lbs. per ton of iron lowers the sulphur from about 0.135 to about 0.100 per cent.

Melting

Pouring: Spout temperatures range from 1,530 to 1,545 deg. Optical pyrometers are used. These are frequently standardised and the temperatures are accurate, as has been shown by an occasional check with thermo-couple pyrometers. Test sprues 2 in. in diameter, 8 in. long are poured at 4- to 5-min. intervals. These bars are quenched in water after cooling in sand for 6 min. The fracture gives the experienced operator an accurate control of his metal. There checks are further substantiated by hourly chemical analysis. The wall thickness on all castings poured with this type of iron ranges from a minimum of $\frac{3}{32}$ in. to a maximum of $\frac{1}{4}$ in.

[3] "Metal Progress," March, 1935.

Standard A.S.T.M. test-bars are poured at 1-hr. intervals. The analysis of these bars is checked immediately from samples obtained by pounding up shot from this metal. This method is checked periodically by drilling samples from corresponding large test-blocks. Starting with a temperature of 1,535 deg. C. at cupola spout, the iron runs first into the back of the mixing ladle, where it is desulphurised and then is tilted by remote control into 100-lb. pouring ladles.

Fluidity.—A very good idea of the fluidity of the metal as related to very thin castings may be had by observing the manner and time of filming over of the top of the sprues. Occasionally, on days with high humidity, this filming over of the test sprues is a matter of very few seconds. The breaks in the film will occur very fast and will be of short duration. The appearance of the test-bar fracture, however, does not seem to be affected as would be expected in the case of slight oxidation.

Incidentally, this occasional trouble in lack of fluidity on high humidity days, as evidenced by the special fluidity test and filming-over characteristics, has been considerably reduced since the management started adding the silicon in the form of briquettes. The writer is now interested in an investigation to determine, if possible, just what influence silica may have with the above-mentioned phenomenon, but as yet has no conclusive data.

Physical Tests

Standard $\frac{3}{8}$-in. tensile test-bars are cast in duplicate each hour, each bar having the month, date, and hour cast on each end. In the same mould is cast a 5-in. wedge, 1 in. wide, $\frac{3}{8}$ in. thick at one end, tapering down to $\frac{1}{8}$ in. at small end, and a 1-in. by 1-in. by 5-in. square bar. The wedges are annealed, broken, and filed according to date, with the corresponding tensile and square hard-iron bar. Years ago, the wedges were galvanised and broken as a check on deterioration. But since no indication of galvanising embrittlement has been noticed in any of these bars in the past five or six years, it is now standard practice to include this, with the routine impact tests on actual fittings taken from each annealing pot and galvanised.

Machinability

Machinability can be checked fairly close on the fittings, since the hardness and microstructure of the cutters are controlled by the laboratory. Complete data on fittings tapped between grinds is available for each size and each machined speed.

Effect of Machining Off Outside Skin of Cupola Malleable Test-Bars.—Letters arrive, almost daily, from prospective users of malleable iron, seeking information on some phase of the relation between physical properties of the surface and centre portions of malleable castings. With this in mind, the metallurgical department has had several hundred test-bars machined from the regular $\frac{3}{8}$-in. dia. to $\frac{1}{2}$-in. dia. Each machined bar had its companion $\frac{3}{8}$-in. dia. as-cast bar, for comparison. The average results were as follow:—

	Elongation. Per cent.	Yield point. Tons per sq. in.	Tensile strength. Tons per sq. in.
As-cast $\frac{3}{8}$-in. bar ..	9	15.2	21.4
$\frac{1}{2}$-in. bar machined from $\frac{3}{8}$-in.	9.5	15.3	21.3

It is believed that, so far as yield and strength are concerned, the difference is negligible. The slight difference in elongation is probably due to the uniform cross-section and surface smoothness of the machined bar. These results are not in conflict with those reported very briefly in the A.F.A.-A.S.T.M. Symposium on Malleable Iron.

Material Strength of Cupola Malleable Fittings

The average load to separate a $\frac{3}{4}$-in. union made at the writer's plant and tested in accordance with Navy Specification 45-U-3-C is 17,500 lbs. The maximum variation on over two hundred $\frac{3}{4}$-in. union tested was 2,000 lbs. This is well above the navy specification which calls for 10,600 lbs. on this particular size and class. Water-bursting strength on ells of this same size, standard weight, averages over 8,000 lbs. per sq. in.

Conclusion

Some years ago the production of malleable castings by the cupola process was attended by many difficulties. Since the era of metallurgical control, the picture has changed to a very great extent. To-day castings are being made by the cupola process with definite standards for composition and analysis. Some of the great helps in producing these castings to-day are accurate and quick chemical analysis, reliable optical pyrometers, greatly-improved mechanical equipment, such as chargers, multiple-beam scales which ensure accurate composition of the charge, variable-speed motors with controlled blast, physical testing equipment, and frequent furnace tests. By such means the management is able to make a uniform malleable product with excellent machinability, with ample physical properties, and with uniform integrity.

Publication Received

Labour Turnover and How to Reduce It. Published by the Industrial Welfare Society, 14, Hobart Place, Westminster, S.W.1.

Before we examined this pamphlet we had the idea firmly fixed in our mind that in Great Britain the problem of "labour turnover" did not exist, and there is nothing within its twelve pages to make us alter our opinion. The incidence of the Employment Exchanges as a feature in British industrial life has tended to reduce rather than to augment the questionable disadvantages of "labour turnover." Assuming that the pamphlet is correct in stating that "an excessive labour turnover cannot fail to have serious social consequences which cannot be estimated in terms of money" (which the publishers promptly attempt to do), we presume we have the right to estimate the effect in a similar way.

(*a*) The interviewing of new applicants brings a wealth of knowledge to the hiring firm as to methods and conditions in operation elsewhere.

(*b*) The instruction of new employees usually teaches the teacher more about his own machines and processes, especially when the newcomer is experienced.

(*c*) Increased wear and tear of machinery by the new employee may be counterbalanced by the new notions he may bring to bear.

(*d*) and (*e*) Early low production and high-wastage loss may be neutralised later by enhanced output of better quality.

We grant there is a greater liability to accidents amongst new comers (*f*), but by the process of labour turnover a foreman is obviously surrounded with people who like working for him, and workpeople are able to find more congenial shops from their point of view. The greatest factor, completely ignored by the pamphlet, is that only by moving about from one works to another, within reason, can real valuable experience be acquired. The only useful part of this book is the disclosure of a common-sense method of computing and recording labour turnover. For the rest, we advise our American readers to study the pamphlet, as in that country there certainly was, when trade was booming, a real "labour-turnover" problem, due to a very healthy desire on the part of their citizens to make more money.

Welfare Work in Relation to Foundries

NO SPECIAL PROBLEMS INVOLVED

A meeting of the London Branch of the Institute of British Foundrymen was held at Charing Cross Hotel, London, W.C.2, recently, Mr. V. Delport (Branch-Vice-President) in the chair. The meeting was informed of the recent death of Mr. Finch, one of the founders of the Institute, and its first hon. secretary. As a tribute to the memory of Mr. Finch, the meeting observed a period of silence. The members of the Branch offered a warm welcome to Mr. John Cameron, a Past-President of the Institute, who attended the meeting.

A Paper on the subject of "Welfare Work in Relation to Foundries" was then read by Mr. R. R. Hyde (Director of the Industrial Welfare Society).

Special Features of Foundry Welfare

Mr. R. R. Hyde began by pointing out that welfare work in a foundry was very much like welfare work in any other occupation, but from time to time he referred to special features connected with foundry work. He outlined briefly the history of the industrial period, showing that in the early days masters had overlooked the human considerations, which alone could make for contentment and efficiency; but he added that throughout this dismal period there were always men looking forward to the creation of a society in which men could co-operate. The injustices of that period had led inevitably to an age of protest, which was followed by a long period of reconstruction led by such pioneers as the Cadburys and the Rowntrees. Welfare work was the outward expression of this new conception, and at the outbreak of the war a number of schemes were in existence in this country. The demand for war material had made it necessary for hundreds of thousands of persons to engage in productive enterprise without any previous experience of workshop life; the employers were fully occupied on production, and the human side of industry was in danger of being overlooked. To meet this danger, a Welfare Department was set up at the Ministry of Munitions, in which the lecturer played a prominent part. Towards the end of the war he came to the conclusion that the promotion of better relationships and improved working conditions was a matter for industry itself to undertake, and a voluntary organisation, the Industrial Welfare Society, was formed to encourage the employer to develop welfare activities and to serve as a clearing house of information. The membership to-day is about a thousand firms, each of which pays a nominal subscription for the service rendered by the Society. There was need, he said, for a greatly increased membership if the work were to grow as it deserved.

A Welfare Policy

One of the Society's main appeals to industry was that every employer should have some definite policy for his undertaking, and that that policy should be known to every worker. Also, in every firm of every size some person should be responsible for dealing with all matters relating to the health, the well-being and the safety of the workpeople. In some of the larger concerns, where many thousands of people were employed, this involved the employment of a staff of employment managers, medical men, nurses, and so on; but in the very small units one of the directors should undertake this responsibility.

Every firm should ensure, by means of a handbook, or something of that sort, that the workers knew just what the firm was about. If industry were to be a partnership, not necessarily of money, but of interest, it was reasonable that new workers should know something about the co-operation of the people with whom they were working; and there was a growing tendency, among many progressive firms, at any rate, to ensure that the facts were contained in a book given to new workers when they joined the firms. Again, methods which in the past had often led to feelings of injustice and to complaint—including methods of unfair promotion—must be replaced by more reasonable methods if industry were to survive happily.

There were hundreds of thousands of people in the country who were prepared to spend their days doing monotonous and dull tasks; and but for such people the country would not survive. In a confectionery factory recently he had met a man who spent eight hours a day placing small pink blobs on chocolates—and that man was happy. But the demand was growing for men capable of doing something more, and in this country the shortage of skilled labour would become a very serious menace in the near future, not only in foundry work, but in engineering also.

Works Committees

Then there were many questions of relationship that ought to be tackled, and could be tackled where there was a will, and he mentioned the success of the system of works committees. He quoted, for example, the case of the amazingly successful series of committees at the Stanton Ironworks. However small a concern, there were ways in which the thought and expression of the workers could be given an outlet for the benefit of all connected with it, and opportunity could be given to workpeople to make their complaints without being victimised. It had been suggested in some quarters that the number of complaints had increased enormously; but that was not true. The point was that, when people knew they could make complaints without being made to suffer, they were willing to make them; but that did not mean that there was more to complain about. It was worth while to ensure that complaints should be brought to light. Again, many of the committees were handling benevolent funds; and it was far better to allow the workpeople to handle their own benevolence than that they should have these things imposed on them from above or from without. Hundreds of such funds were being administered most effectively by the workers themselves. It could quite readily be understood that many questions relating to accidents and their causes could best be handled—where matters of discipline were not involved—by the people in the shops. Social activities should not be imposed from above upon the workers, but controlled and directed by the workers themselves. Possibly about 200 large firms were issuing works magazines. For example, Imperial Chemical Industries, Limited, had a magazine with a monthly circulation of about 40,000 copies; the magazine of the L.M. & S. Railway had a circulation of about 150,000 copies. In large concerns magazines did offer media by which the executives and operatives could exchange views and learn something about each other.

Utilising Spare Time

At this stage Mr. Hyde recounted a very human story to illustrate the frame of mind of one of the hundreds of thousands of workers who never came into the limelight. Many people in the world, he said, were in the limelight a great deal, but many others were really obscure; if anything could be done, for instance, to give an employee a "write-up" in the firm's magazine, or to give him a pat on the back on the occasion of the annual meeting, for having completed many years service, or for some other reason, it would meet a very important human need. The editor of the magazine published by one large firm had established the practice of interviewing the older workers when they went away on pension. On one occasion he had asked an old worker, who had been engaged on repetition work for a great many years, what he would do in his spare time, and the man had replied that he would build a shed. Questioned as to what he would do after that, the man had considered the question for a few moments and then had replied that he would sit in it. Mr. Hyde described that story as one of the most tragic he had heard in modern industry. Unless there were somebody in a works who knew what the workers were thinking and was able to represent some kind of human view to them, that works would suffer. Although all this might sound sentimental, Mr. Hyde assured his hearers that it was not sentiment.

An American Experiment

In this connection he referred to an experiment made some years ago by a well-known American psychologist, Elton Mayo, in the Western Electric Company's Works in Chicago, with a view to discovering the factors in industry which made for efficiency and sound relationship. It was the only experiment of its kind ever carried out on a really big scale, and it had occupied some years. It related to a team of girls employed in the assembling of telephone relays, and attention was given to material matters such as bonus on output, shorter days and shorter weeks, more holidays, a break during the morning shift, and even improvements in ventilation, lighting, and so on. The results of the experiment were at first rather baffling, and it was decided to revert to the original conditions existing before the experiment began. During that period the output increased. Therefore, the more material matters were dropped, and a study was made of the very simple question of relationship, which factor made all the difference. The girls in the team no longer felt that their job was in jeopardy, but that the employers were taking an interest in what they did. The girls became so interested in their work and in each other that they went for holidays together, and nothing would interfere with the team spirit which had grown up. As the result of the experiment the company had concluded that the one important factor in efficiency and sound relationship was that of the right supervision of the workers. Elton Mayo had published a book, "Some Human Problems in Industry," in which he had dealt with that experiment—and it was worth reading.

Preventing Illness

With regard to health, there were 50 or 60 firms in this country which employed doctors in their works to *prevent* ill-health arising—and one wished there were more. In one of the London stores about six years ago a lady doctor was appointed, and there was a certain amount of cynicism and amusement on the part of some of the directorate. The doctor's salary was £750 a year; but last year that doctor had given the firm healthy labour to the value of more than £12,000. The average number of days lost had been reduced from 10 to something like 3, and if one considered activities of that kind simply and solely on a cash basis one found that it was worth doing. Certainly from the point of view of the workers it was more than worth doing, for they were saved endless suffering, mental worry, and so on.

Workers to-day were being exposed to far more risks and hazards than ever in the past, if only as the result of handling new materials about which we knew very little, and it was important that there should be somebody on the spot who could watch new health risks as they arose. The medical side needed watching if

industry were to cope with the new stresses that were being laid upon it, through international competition and other factors. The proper equipment of canteens was another quite modern movement which had made its contribution to the well-being of the workpeople.

Monotony and Selection

There was another group of questions in the welfare field, arising from the use of the machine. It was sometimes stated that there were workers who had been engaged day after day and year after year on repetition processes and that they had been broken at it, yet there could be found but little evidence of that result. It might be felt that such work must be soul-destroying; but no evidence was forthcoming. Although some persons would probably go insane if they had to do a monotonous job for an hour or two, there were others who liked monotonous jobs. The important consideration, therefore, was to try to select for such work the people who liked to do it, and to set aside other people for other work; and that problem was demanding attention. The old craftsmen usually said that people were being taken from the bench and put to repetition work, but that was not true. Modern conditions were mixing a medieval conception of industry with a new conception.

Rest Pauses

Rest pauses had been introduced into the middle of shifts, with very beneficial results. In a foundry, rest pauses were probably created naturally, by the nature of the work; but where the workers were dependent for the flow of their work upon the movement of a machine it was very often necessary to introduce an artificial break in order to give them a rest from a long-drawn-out and possibly drudging operation. In many firms the workers engaged on such processes had been offered a change of job, but the difficulty was to get them to make the change. Even where a number of girls were engaged on some group assembly it was very difficult to get them to change round and work in another sequence. At any rate, industry was watching this question as an essential part of welfare work.

Reactions!

It was sometimes stated that in modern industry there were no incentives; and that was one of the most difficult questions to settle. There were profit-sharing and co-partnership schemes, and many other incentives were offered to give the worker an interest in his job. Yet very often these incentives led to very grave disappointment. In one big modern factory the boys were given a week's holiday in return for good time-keeping, and the boys were very keen about it. Two or three weeks after the introduction of that scheme a deputation of the older men had asked that they might wait upon the directors, and the directors had seen the men. The latter had complained that the boys were so keen to get to their jobs in the mornings that they rushed up the stairs and almost carried the men with them, and the men asked to be allowed to use another staircase in order that they could go up at their own pace!

At one large firm in Scotland, where a co-partnership scheme was instituted, whereby the workers were given opportunities to own some of the £1 shares, a director had met one of the older workers on one occasion and had asked if he were in the scheme. The worker had replied that he was one of the shareholders. In fact, he had secured one share; and in reply to the comment that that was not very much, he had replied that if the business failed he would not lose very much, but if it succeeded he could claim to have had some part in its success!

Another firm, which had enjoyed a very good year and was pleased with the results, had held a public meeting at which profits were shared with the workpeople. The workers' shares amounted to the equivalent of four weeks' wages. That basis was revealed at the meeting, and it had been announced in the Press that one worker had received £15, another £20, and so on. But the wives of these men had made their own calculations; so that when a wife had learned that her husband had received £20 as equivalent to four weeks' wages, and he had only admitted having earned £3 15s. per week, there had been a little unpleasantness! The firm no longer held public meetings at which to distribute profits.

Entrants to the Foundry Industry

One of the problems of the foundry in the future would arise from the unwillingness of the modern boy to work in a foundry. For some reason, the conditions in many of the older foundries did not appeal to the modern boy, and Mr. Hyde said he had received complaints with regard to that matter from all parts of the country. Whether or not the advent of the mechanised foundry would make any difference to that he did not know, and whether or not foundry work would give place to fabricated steel he did not know. Two years ago he had visited a marvellous mechanised foundry on the Continent, but it was found that the mechanisation could not be taken advantage of fully owing to the variety of the parts made there. It was a beautiful demonstration of somebody's efficiency, and perhaps of the wealth of the firm. However, much could be done to clean up some of the foundries he had seen; in the light-castings district of Scotland some of the conditions were rather fearsome, and many suggestions could be made to improve the conditions in the shops there. To see an artist at work in the foundry, for instance, doing things almost inconceivably clever, appealed to him; whether or not it would appeal to the modern boy was a question for industry as a whole. One did not know whether a change of view could be effected by following the example of the mining industry, which had installed pithead baths for the men in order that they might be clean when they left their work. It was curious how the miners had taken to that system. In 1919 it was almost impossible to raise any enthusiasm among the miners for the pithead baths. Now, however, there are 286 pithead baths in the country. Only a week ago he had visited a colliery at Sherwood, and the miners came away from the pithead as clean as though they had been working in an office. The modern boy had a great dislike to appearing in public dirty and untidy, and there was a good deal in that aspect of the matter.

Accident Incidence

Much remained to be done in the direction of preventing accidents. He had no figures in respect of accidents in foundries in this country, because the foundry figures were not kept separately. But an analysis was made in America last year, and of 100 accidents in a foundry, 32 were due to handling objects, 18 were due to machinery—a rather high percentage as compared with accidents due to machinery in other branches of industry—10 were due to electricity, explosions or burns, and seven were due to falling objects.

Referring to means of protection, such as the use of goggles for the eyes, Mr. Hyde said he was particularly interested in the proper treatment of eye injuries, for he had been associated with one of the big London eye hospitals and had seen a good deal of eyes that had gone wrong. Risks were taken daily, and very keen attention should be given to the matter. To some people, an accident just meant a Home Office record. To Mr. Hyde, however, an industrial accident meant that someone had to visit a little house and tell the woman who answered the door that her husband or her brother or her son was dead or was mutilated and was in hospital. Often that had been his experience; and unless an accident had that meaning to people generally, they should never be able to impress upon them the fact that the prevention of industrial injuries was worth bothering about. It was the only appeal worth making.

At a works in America, when a man's hand was severed, the manager called together the whole of the workpeople and frightened them by producing the severed hand. Mr. Hyde regarded such a method, however, as inappropriate.

At a rubber works which he had visited in Russia four years ago he had learned of a practice instituted with a view to preventing accidents as far as possible, and very seldom did an accident occur there. In the event of an accident, the manager lost all or part of his salary until the victim had recovered. On one occasion a benzene plant had blown up, with the result that two men were killed; the manager had lost his salary for seven months.

Accidents were to a great extent the result of the rapid industrial development. After generations of isolated work in the fields, accustomed to very slow movements of the scythe, the sickle, and so on, men found themselves after little more than a generation of development thrust into a multitude working amongst rapidly-moving objects; they were not accustomed to it. That was a simple explanation of most accidents. Whether they liked it or not, those were the conditions of industry in this country. Through the work of accident committees, the use of posters, etc., and in many other ways, the management could reduce the number of accidents, and a reduction was being effected; but Mr. Hyde regarded the personal field, the education of the workers to avoid accidents, as being by far the most effective means. Industry would never get rid of the problem of the man who did not care, or of the odd things which occurred from time to time and which nothing on earth could guard against.

Last year, in Nottingham, a party of foremen drawn from different factories was taken around some of the big works; that tour had been well worth making, and others would be arranged. There had been exchange of views on almost every conceivable kind of question. Two of the men had worked for 38 and 40 years respectively in their particular factories, and had never seen the operations in any other.

There were many extraordinary things in industry to-day of which some people were not aware. The Society was very busy, in conjunction with the British Medical Association, dealing with the almost incredible state of affairs in connection with fracture cases. The way in which fractures were handled and treated, and the amount of suffering involved, was almost past belief. There was a report of the British Medical Association on the question, and it must be tackled in the very near future, because we could not continue losing efficiency and losing life or piling up the burden of suffering, when as the result of very little effort the whole thing could be put right.

The movement to improve relations and conditions in industry was not confined to this country. The Society received inquiries from all over the world, the most insistent inquirers being the Japanese. Recently an Industrial Welfare Society was started there, and there was the delightful position that the Home Office staffed this voluntary organisation. He understood that they tried to persuade an employer to do this or that as a voluntary effort, but if their persuasion failed they put on the mantle of the Home Office and compelled him. That was a very expeditious manner of effecting reforms!

There was no doubt whatever that industry throughout the world was beginning to see that the factor which would matter in the future was not so much the machine, which was common to the world, but the effective use of the man-power behind the machine. Mr. Hyde still

believed that both here and elsewhere we were yet a long way short of settling all the injustices and hardships and discontent; but without doubt those in this country were better in this respect than their fathers, and industry was better for the workers in it than it had ever been in the past.

DISCUSSION

The CHAIRMAN (Mr. V. Delport) commented on the fact that the subject of the lecture was unusual for the Branch, but it had been dealt with in a very human way; the question of welfare in industry seemed to be much wider than perhaps some had realised.

MR. F. GENTLES, discussing the problem of attracting boys to the foundry, said that in the establishment with which he was associated there was a general shop and machine section. The general tendency was for the boys to go into the machine section for a short time, but they appeared to become tired of it—he supposed it was a psychological factor—and a good many of them came into the big general shop. The liking and the aptitude for foundry work was perhaps largely hereditary; he and his five brothers had drifted into the foundry as a matter of course. Although at first he had been employed on the railway, which was supposed to be a nice clean job, he had run away from it within 18 months in order to get into the foundry.

Whether or not one could get the workmen as a whole to realise that the welfare work was for their benefit was a matter about which he had grave doubts. In the past he had experienced a few heartaches when trying to teach men to do something for their own benefit. However, though doubtful, he was hopeful.

The CHAIRMAN said that the main point in Mr. Hyde's lecture, and the one which should be emphasised and which went further than the actual question of welfare, was that of the relationship between the directorate or the management and the workers. Whatever the heartaches one might experience, it was the management's job to bring about that better relationship. If a worker felt that he was only a cog in the wheel he became interested only in his daily earnings, and if he found an opportunity to earn more in another concern he would have no compunction about changing. If, on the other hand, he felt that his interests were being cared for and that there was a human relationship between him and the management, he would hesitate to leave, even for higher pay.

With regard to prevention of accidents, it was not merely a question of taking the necessary material measures, such as protecting the machinery, and so on; it was very largely a question of educating the worker. In many cases, although all the measures that could be thought of were taken to prevent accidents, the workers would forget about them and would proceed on the old lines. Sometimes a man would meet with an accident, and six months or a year later he would meet with another accident due to the same cause. Similarly, the problem of preventing accidents in the streets was largely a matter of educating the public. It would be a long process.

MR. W. O'KEEFE commented that some were concerned as to where to draw the line between welfare work and some other things which were closely allied to it, such as bonus systems for increased output; such systems were introduced as an inducement to the worker to produce a little more, and were not necessarily welfare systems. The care of the health of the workers was, however, essentially a matter of welfare; the essential thing was good health, and Mr. Hyde and his organisation could do a great deal of good by bringing before the employers and employed the essential factors for the maintenance of good health in industry. It was the duty of an employer to ensure reasonable efficiency in his employees, and if he were wise he would do everything possible to ensure that his employees were fit so that they could perform their tasks well. For instance, sometimes a man would suffer from headaches almost daily, perhaps due to optical trouble. If he reported the matter to the welfare department he would be given the opportunity to discuss it with, and to be examined by, competent people, who would be able to put the matter right by prescribing eyeglasses or by some other means. As a result, the man would work better and would probably be able to remain in industry for years longer than he would otherwise.

MR. G. C. PIERCE (Past-Branch-President) asked if Mr. Hyde would agree with the view expressed earlier that it was rather hopeless to attempt to educate foundry workers to be clean and to make proper use of the facilities for improvement which were introduced by welfare workers.

MR. S. CAREY, bearing in mind the large number of small factories in the country, which might not have sufficient money to be able to establish elaborate welfare departments, said that the problem boiled down largely to persuading the individual workers to fall into line with the suggestions made by welfare workers. He, personally, had found that the average moulder or the foundry labourer had a most peculiar temperament, much different from that of workers in some other industries, and they resented what they regarded as interference. Many men, if they were told not to do something they were in the habit of doing, would down tools and walk out. That, however, was a very short-sighted policy. Again, in some places a good deal of money had been spent on the provision of good lavatories, and it was expected that they would be kept clean; but they did not remain clean.

Lecturer's Reply

MR. HYDE, replying to the references made to the difficulty of persuading people that they were being taught for their own benefit, said that that touched the depths of human nature. The imposition of the 30 m.p.h. speed limit on the roads was an attempt by the Ministry of Transport to educate road users, for their own benefit; but apparently motorists did not adhere to it rigidly. However, there were many works in the country in which, due perhaps to tradition or leadership, the efforts of the employers were very warmly welcomed and appreciated by the employees. He did not think that anybody could lay down a scheme and say that it was the right scheme, which would have the support of the workers; it was more a question of leadership and personality.

If an effort to improve matters in a works did not meet with a good response, one should not just give it up, but should continue trying. In introducing various improvements, one might be cutting across the traditions of generations. In some families, foundry work was in the blood, for instance; in some families, or districts, there were all sorts of ill-traditions, and it was very difficult to eliminate them. Efforts had been made again and again in some firms to improve matters by providing good lavatory accommodation, soap, towels, etc., and at last they had come to be appreciated.

One of the first contacts Mr. Hyde had made in connection with the welfare department at the Ministry of Munitions was with the late Mr. Arthur Henderson—who had been a member of the Institute. In those early days Mr. Henderson was chairman of the Labour Advisory Council. He had stated, quite truly, that in the past in this country many movements, such as the welfare movement, had been used in order to exploit the workers; but if the movement were sincere, it would command the wholehearted support of labour. Mr. Hyde accepted the challenge at the time; and it was pleasing to him, therefore, to realise that to-day welfare work has the backing of trade unionists all over the country, simply because it was not being used to exploit the workers.

Commenting on Mr. O'Keefe's reproof with regard to incentives, such as bonus payments, Mr. Hyde said that ordinarily his society did not interfere with questions of wages, preferring to leave such matters to the appropriate bodies.

He would like very much to be able to find out the state of men's minds at times when accidents occurred, and he had asked one or two firms, in which the relations between the workpeople and the management were friendly and above suspicion, whether it would be possible to inquire into that matter. Sometimes a man met with an accident, perhaps, because his mind was occupied with some domestic trouble or something else which had worried him, so that he began to forget the risks he faced at his work. He believed that in the streets also that was one of the most important causes of accidents.

The appeal to self-interest was quite sound, and he personally was never afraid of that appeal. It was far better than hypocrisy, and it was an appeal which could be used in connection with welfare work.

In some textile factories, where girls had to concentrate on very fragile thread and strained their eyes as a result, experiments had been made in the use of prismatic lenses, which had given tremendous relief.

The institution of savings funds was very important indeed; some firms added to the amounts saved by the workers, but only on condition that the workers actually spent a holiday away from home. Such firms did not force a man to go away for a holiday, but merely offered to add to his holiday savings if he did go away. All sorts of schemes of that sort were in operation, and they were all to the good.

As Mr. Carey had intimated, the problem of dealing with small factories was a real one. It did not depend, however, wholly upon having plenty of funds available. He mentioned a case in which it was decided to clean the windows and floors of a works, where sufficient lead was recovered from the floors to pay the cost of the cleaning ten times over. Welfare work often resulted in the saving rather than the expenditure of money.

Dealing again with the difficulty of securing a response on the part of the workmen, he said that in one big foundry where various schemes had met with no response at all it was suddenly realised by the man in charge that the foundry was a very bad place in which to work; the conditions there were wrong. During rainy weather the water would leak into the shop and the tools would get wet, in the winter the tools would be covered with ice, and everything was cold and miserable. It was for that reason that the men had such a sullen outlook on life, although they had not realised it. When the foundry was tidied up and the conditions improved, they had given a better response. That general disgruntled feeling, due to the working conditions, was often the reason why the efforts of the welfare enthusiast failed.

Vote of Thanks

MR. G. C. PIERCE, proposing a vote of thanks to Mr. Hyde, expressed his concern about the difficulty of attracting boys to the foundry, and said he could give figures to disprove the view that craftsmanship would become unnecessary by reason of the mechanisation of foundries. He believed that the demand for craftsmanship would increase, and he was appalled by the dearth of boys entering the industry. The attitude of some employers towards this matter was very disappointing, and some were approaching the problem from the wrong angle, in his opinion, when they made it a condition of employment that boys must attend evening classes on three evenings per week, after a day's work in the foundry. He could give instances in which boys, with an aptitude for foundry work,

(*Concluded on page* 404)

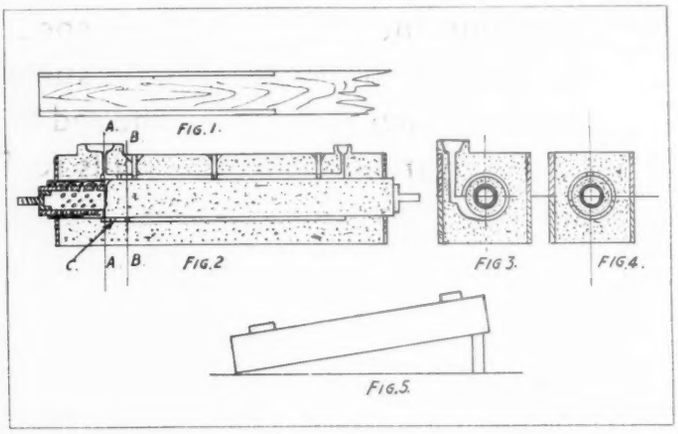
Leaves from a Foundryman's Notebook

IV.—HYDRAULIC CASTINGS

By "RECORDER"

Castings which have to withstand hydraulic pressure tests or which are incorporated in hydraulic machinery have to be well and carefully made, and an example taken from the practice common a good many years ago in a district famed for its hydraulic machinery and which can still be regarded as an example of good foundry practice is the subject of the following leaf from a foundryman's notebook.

Fig. 1 shows a section of the finished casting. It is a plunger pole for a beam-type pumping engine, and consists of a cast-iron pole turned bright on the outside and fixed to a baulk of timber which is forced through the centre of the casting and securely fixed by wedging. This is then connected to the main beam of the engine. The pole works in a pole case through a stuffing box and gland, and is used to force water through the valve boxes situated under the pole case.



Though apparently a comparatively simple casting, great care has to be exercised to ensure a clean face all over the outside and to obtain a pressure-tight job. Although casting on end would seem the ideal way of making these poles, the method about to be described has given every satisfaction. Fig. 2 is a section through the cored-up mould, whilst Figs. 3 and 4 are cross-sections at A and B in Fig. 2 respectively, showing the runner arrangement, which consists essentially of a dirt trap. The pattern is made about 1 ft. 6 in. to 2 ft. longer than the required casting, and in this additional length a series of grooves are formed which serve to catch any dross or dirt which may have entered the runner. This is illustrated at Fig. 2, C, and by the sections, Figs. 3 and 4, the metal entering the mould by way of the opening between the built-up grooves. The pattern equipment for a job of this description is very little; for example, that required for a 16-in. dia. pole, 12 ft. long, 1¼ in. thick, would be one barrel pattern in halves, 16½ in. dia., 14 ft. long, with core seats at both ends, one core board, and one gauge for forming the dirt traps.

The core board would have three gauges for testing the diameter of the core at three different places, at both ends and in the centre. The core is made of these varying diameters to allow of the easy insertion of the baulk of timber in the resultant casting. For a 16-in. pole as the example taken, the sizes would be one end 13$\frac{9}{16}$ in., middle 13$\frac{3}{4}$ in., the other end 13$\frac{11}{16}$ in. The middle is made bigger to allow of the wooden connection passing down easily, and the 13$\frac{11}{16}$-in. end allows of the job being wedged tightly, this being accomplished by driving a large number of pick hilts into the end of the baulk of timber.

The core is made on a core barrel and struck up in the usual way, resting on trestles. Cores made by this method have been known to give trouble through one or more of the following faults, either in the straw rope or in the core barrel. The core may be faulty because the straw rope is not of equal construction throughout; this is mostly apparent on ropes spun at the foundry, and the purchase of specially-prepared rope by reliable makers tends to obviate this difficulty. The core bar being bent can also be responsible for a faulty core, the tendency to bend being apparent in a wrought-iron bar more than in a cast-iron one. Core bars buckle when left in the casting too long; the correct procedure is to withdraw it from the casting as soon as this is lifted from the mould.

A further cause of buckling of the core bar would be the upward thrust of the metal when the mould is being filled, sometimes spoken of as "the lift of the metal." To guard against this, which would cause the casting to come thin on top, three studs or chaplets should be used on top of the core.

The method adopted is shown in the illustration. At three places on the top side of the core—measured off by the moulder, to ensure correct location with his mould—there are embedded until reaching the corebar three pieces of iron which are made-off flush with the top of the core. At the points these will occupy in the mould, three holes are made through from the top, through which three studs or bright-steel bars—threaded at the place they remain in the casting, so as to hold pressure tight—can be inserted. The mould being assembled, these three studs are lowered through the top box on to the previously-prepared places in the core.

To avoid the shifting of these studs, a little iron is run around each of them and allowed to set before the job is cast. The core is made of the varying diameters previously referred to by springing the board slightly, accuracy being tested by the gauge sticks. These cores are run up in two thicknesses of loam, a ¾-in. coat is first run on and allowed to stiffen, and then a finishing coat is applied. The casting position of this job is shown in Fig. 5, the mould being placed on the incline, the runner end the lowest. The reason for this is, supposing any dross should enter the mould—having escaped the dirt trap—it would be carried along by the stream of metal, together with anything which might wash off the face of the mould or core, and ultimately would float out at the riser. This method can be employed to produce these poles or hydraulic rams quite satisfactorily, and is a considerably cheaper means of production than vertical casting, which entails a large amount of extra work.

Welfare Work in Relation to Foundries

(*Concluded from page* 403)

had been driven to evening classes, and had subsequently left the foundries because they had become disgruntled. He believed in education, but at the right time, and was certain that it was not right to send the boys to evening classes after a day's hard work, as the only means of educating themselves. Many of them had to travel considerable distances from the works, and when they had travelled home, then back to evening classes and back home again, they were over-tired.

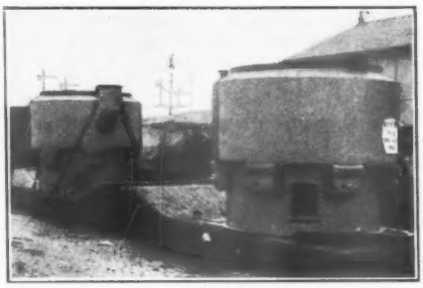
He personally had noticed a very definite improvement in the attitude of foundry workers during the last 25 years, and challenged the view that it was a hopeless task to try to introduce improvements.

MR. F. GENTLES seconded the vote of thanks, which was carried with enthusiasm.

MR. HYDE, in his response, agreed that it was an old-fashioned and stupid system to insist upon a boy learning his job in his own time. It was to the advantage of both the employer and the boy that the latter should be given time for education during the day. Henri Deman's book, "Joy in Work," contained a very fine piece of reasoning with regard to the need for craftsmen in the future, and the semi-skilled man as compared with the skilled man, and it formed enjoyable reading. Foundrymen would derive many useful thoughts from it.

Giant Melting Plant

Two of the largest foundry cupolas in the country are this week in course of transit from Birmingham to Middlesbrough. Each cupola, when erected, will be approximately 60 ft. high, the shell diameter being 8 ft., and the air belt diameter 10 ft. They have been built by the Constructional Engineering Company, Limited, of Charles Henry Street, Birmingham, and are of special construction for the Stanton Ironworks foundry, where they are to be used for continuous melting in connection with the manufacture of cast-iron pipes. With one exception, they are believed to be the largest cupolas to operate in this country.



AN "OUT-SIZE" CUPOLA ON RAILS FOR DELIVERY TO THE NORTH-EAST COAST.

The transport of this plant necessitated special arrangements being made by the railway companies concerned, more especially in connection with single-track working from Normanton to Middlesbrough, and the two cupolas are the largest consignment of melting equipment handled by the railways for some years. The photograph shows the air-belt section of each cupola loaded on railway trucks ready for despatch.

XUM

Eliminate 4/9ths. of your Fettling Costs

Bakelite-bonded Grinding Wheels are made to run at a surface speed of 9,000 feet per minute, whereas the speed of Vitrified and similar Wheels is 5,000 surface feet per minute. This increase in Wheel speed means an increase in the speed at which metal is removed by the Grinding Wheel—9 is to 5—nearly twice as fast.

You cannot afford to use 5,000 feet per minute Wheels.

ROWLAND HIGH SPEED FLOOR GRINDERS have been designed for 9,000 feet per minute Wheels. You cannot run a High Speed Wheel on a slow speed Machine.

F. E. ROWLAND & Co. LTD.

CLIMAX WORKS, REDDISH, STOCKPORT

Buy from the grinding machine specialists.

This Week's News in Brief

Trade Talk

AT FALKIRK DEAN OF GUILD COURT this week the Grahamston Iron Company, Limited, were granted a warrant for the erection of an additional stores building.

THE CZECHO-SLOVAK engineering concern, the First Brno Engine Company, has secured a contract from the Turkish Government for the supply of 30 large steam rollers.

AT AN EXTRAORDINARY GENERAL MEETING of the shareholders of the Dalness Forge & Engineering Company (Glasgow), Limited, held in Glasgow, it was decided to wind up the company, and Mr. Robert H. Clark, C.A., 124, St. Vincent Street, Glasgow, was appointed liquidator.

THE EMPLOYEES of the North British Locomotive Company, Limited, Queen's Park Works, Glasgow, have contributed during the past year £223 10s. 1d. to Glasgow hospitals and various other institutions. Since the system of contributing was instituted the employees have allocated the sum of £19,739 4s. 3d.

A FUSION IS TAKING PLACE between the important Prague engineering concern of Ringhofer and the Tatra Works (automobiles) retrospectively as from January 1, 1935. The transaction is more or less a formal one, as the Ringhofer concern has for several years past held practically the entire capital of the Tatra Works. The Ringhofer Company has a capital of its own, 47 million crowns, while the Tatra capital is 30 million crowns.

AN ORDER for eight new bells for the Christchurch Cathedral, Victoria, British Columbia, has been received by Messrs. Mears & Stainbank, church-bell founders, of Whitechapel. The bells will be similar in tone and keynote to those at Westminster Abbey. The tenor bell will weigh about 30 cwts. They will be cast in the same foundry in which the bells for Westminster Abbey were made between 1583 and 1919.

DISMANTLING OPERATIONS on the modern part of Mossend Steel Works have begun. The works formerly belonged to Messrs. William Beardmore & Company, Limited, who sold it to Colvilles, Limited, following their decision to centralise activities at Parkhead Forge. Since then Colvilles, Limited, have dismantled the superstructure and transferred the modern parts of the mills to other works. At one time over 2,000 men were employed in the works.

COLVILLES, LIMITED, Motherwell, are manufacturing the steel for the 23 locomotives being made by the Vulcan Foundry, Limited, for the Chinese National Railways. Each engine will weigh 115 tons 16 cwts., and is being built to negotiate curves of 150 metres radius. Six engines fitted with boosters are to run over the northern section of the Canton-Hankow railway, and four over the southern section of the same line. Six others will be loaned for service on the Hanking-Shanghai railway.

THE DETERMINATION by optical means of the stresses in mechanical structures was the subject of a lecture by Mr. H. M. Turner to the Institution of Civil Engineers (Manchester and District Branch). Mr. Turner stated that photo-elasticity, or the optical determination of stress, might be described as the examination under polarised light of transparent models stressed in a similar manner to the structure which was being examined. By applying the method to complex structures, a knowledge of stress distribution could be obtained which could not be calculated by any mathematical means.

ORDERS FOR TWO cargo motorships have been placed by Messrs. Coast Lines, Limited, one with Messrs. Henry Robb, Limited, Leith, and one with Messrs. Ardrossan Dockyard Company, Limited, Ardrossan. The vessel to be built at Leith will be fitted with twin-screw machinery, and that at Ardrossan with single screw. The propelling machinery of the Leith vessel will consist of Polar-Diesel engines, whilst the propelling machinery of the vessel to be built at Ardrossan will be constructed by Messrs. John G. Kincaid & Company, Limited, Greenock. The auxiliary machinery of both vessels, consisting of six sets of Diesel engines, will be supplied by Messrs. Davey, Paxman (Colchester), Limited.

MESSRS. BABCOCK & WILCOX, LIMITED, Renfrew, are the successful tenderers for an important electrical contract valued at almost half-a-million pounds in connection with the extension of Dalmarnock Power Station, Glasgow. Glasgow Corporation Electricity Committee have unanimously agreed to accept two important offers for electrical plant. The first is for the supply of two turbo-generators, each of 50,000 kw., by Messrs. C. A. Parsons, Newcastle-upon-Tyne, whose offer amounted to £353,770. The second contract allocated to Messrs. Babcock & Wilcox is for the two turbo-generators, developing 200,000 lbs. per hr. at a pressure of 625 lbs. per sq. in. The offer in this case amounted to £491,045.

AN IMPORTANT DEVELOPMENT lies behind the announcement that Sir James Lithgow has joined the board of the Fairfield Shipbuilding & Engineering Company, Limited. Sir James is one of the outstanding industrialists of the country. He is chairman of Lithgows, Limited, Port Glasgow, chairman of the Steel Company of Scotland, Limited, chairman of National Shipbuilders Securities, Limited, and a director of numerous other important industrial concerns. The reason for Sir James joining the board is explained in the report of the Fairfield Company. The company had drawn bills for £145,000 on the old Anchor Line, which is in liquidation and unable to meet them, and the liability fell on the drawers. "To meet the situation that has arisen," states the report, "Sir James and Mr. Henry Lithgow have not only purchased, in the name of the Kingston Investment Company, Limited, a substantial majority of the ordinary shares of the company, but have undertaken to satisfy the claims of the billholders and other cash creditors." The report shows a decided improvement in the result of the year's working, the net result being a profit of £29,407, against a loss of £23,000 a year ago. The most significant feature of the report as indicative of the improved outlook in shipbuilding on the Clyde is the increase in the figure for work in progress at the Fairfield yard from £19,470 twelve months ago to £179,835 as at the close of the accounts on June 30.

Ingot Mould Practice

(*Concluded from page* 397)

by fact in this contribution that the source of the iron and the method of manufacture are of first importance.

We think that no one will disagree with the statement that all the items numbered 4 to 11, in the useful summary of factors which influence the life of the mould are in fact of importance and it is interesting to note that particular attention is paid to:—(*a*) The protection of the inner surface of the mould; (*b*) the stripping time; (*c*) the cooling between casts, and (*d*) the manner in which the moulds are assembled during casting.

The latter three factors all bear on the essential point of the temperature range to which the moulds are subjected in service.

Obituary

MR. JAMES HAY, who was for many years employed with Messrs. N. Cockburn & Company, Limited, Gowanbank Iron Works, Falkirk, died recently. He was 62 years of age.

MR. G. J. KITSON, who was for many years managing director of the Monk Bridge Iron & Steel Company, Limited, of Leeds, and a director of a number of other companies, including the Yorkshire Electric Power Company, has died at the age of 74. Mr. Kitson was Lord Mayor of Leeds in 1908.

MR. WILLIAM FINLAYSON, who has died at Sydney, New South Wales, served his apprenticeship with the Carron Company, Falkirk, and went to Sydney 33 years ago to join the firm of Burzacott & Company, rising to the position of manager. Subsequently he founded the Balmain Motor and Engineering Works, of which he was managing director at the time of his death.

THE BOARD OF DIRECTORS of Dorman, Long & Company, Limited, have decided to pay a dividend at 6½ per cent. per annum, less tax, for the year ended September 30, 1935, on 6½ per cent. non-cumulative first preference shares, payable on January 1, 1936, to holders registered December 11, 1935.

Personal

MR. MAURICE E. DENNY, of Messrs. William Denny & Bros., Limited, Dumbarton, was elected President of the Central Board of the Shipbuilding Employers' Federation for the ensuing year at the annual meeting in Edinburgh on November 22. He succeeds Mr. C. S. Swan, of Messrs. Swan, Hunter & Wigham Richardson, Limited, Wallsend. Mr. F. E. Rebbeck, of Messrs. Harland & Wolff, Limited, Belfast, and Mr. F. C. Pyman, managing director of Messrs. William Gray & Company, Limited, West Hartlepool, were re-elected Vice-Presidents, and Mr. John Elliot, of the Mountstuart Dry Docks, Limited, Cardiff, was elected Junior Vice-President to fill the vacancy caused by the election of Mr. Denny to the presidency.

MR. MICHAEL MOLLOY has just retired after a long period of service with Messrs. Watson, Gow & Company, Limited, Falkirk. He started work in 1875 as a grinder with Kinnaird & Ferguson, Queen's Park Foundry, Glasgow, and was shop foreman with Watson, Gow & Company, for over 40 years. Mr. James M. Primrose, managing director of the firm, on behalf of the company, presented him with a wallet of notes, and congratulated him on his wonderful record. Considering his 75 years, Mr. Molloy is still an active man, and until the day of his retirement held his position as the firm's best grinder.

Wills

TAYLOR, THOMAS, patternmaker, 18, Campfield Street, Falkirk £1,404

THOMSON, WALTER J. McL., assistant foundry manager, 19, Sciencroft Avenue, Rutherglen £2,574

MARTIN, JOSHUA, manager of John Whittle & Son, Limited, iron merchants, Whitehaven, and secretary of the West Coast Hematite Pig-Iron Makers' Association £2,262

New Company

(*From the Register compiled by Jordan & Sons, Limited, Company Registration Agents,* 116 *to* 118, *Chancery Lane, London, W.C.*2.)

Whitelegg & Rogers, Limited, Grand Buildings, Trafalgar Square, London, W.C.2.—Capital £4,000. Locomotive and general engineers, etc. Permanent directors: J. D. Rogers and R. H. Whitelegg.

Forthcoming Events

Institute of British Foundrymen

DECEMBER 7.

Falkirk Section:—"Metal Finishes on Cast Iron," Paper by H. Cowan, B.Sc., at the Temperance Café, Lint Riggs, Falkirk, at 6 p.m.

Wales and Monmouth Branch:—"The Constitution of the Properties of Pig-Iron," Paper by J. E. Hurst at University College, Newport Road, Cardiff, at 6.30 p.m.

Lancashire Branch:—"The Dagenham Foundry of the Ford Motor, Limited," Paper by V. C. Faulkner and J. N. Burns, at the Engineers' Club, Albert Square, Manchester, at 4 p.m.

DECEMBER 12.

London Branch:—"Die-Casting of Non-Ferrous Alloys," Paper by N. D. G. Robertson. Joint meeting with the London Section of the Institute of Metals, at the Society of Motor Manufacturers and Traders, Limited, 83, Pall Mall, London, S.W.1, at 7.30 p.m.

DECEMBER 13.

Middlesbrough Branch:—Debate, "That the Scientific Aspect of the Modern Ironfoundry is of Greater Value to the Industry than the Development of Skilled Labour." Proposed by D. Guthrie, and opposed by G. B. Taylor. Cleveland Scientific and Technical Institute, Corporation Road, Middlesbrough, at 7.45 p.m.

DECEMBER 14.

West Riding of Yorkshire Branch:—Open discussion on subjects raised by members at the Technical College, Bradford, at 6.30 p.m.

Newcastle-upon-Tyne Branch:—Discussion on "Strickle Moulding of Large Castings," at the Neville Hall, Westgate Road, Newcastle-upon-Tyne, at 6.15 p.m.

Scottish Branch:—(1) Paper on "Metal Spraying"; (2) Annual Dinner.

East Midlands Branch:—"A Comparison of Some Melting Furnaces in a Grey Iron Foundry," Paper by T. R. Twigger, at the College of Technology, Leicester, at 6 p.m.

The Institute of Vitreous Enamellers

DECEMBER 12.

London:—"Heat-Resisting Alloys," Paper by J. Ferdinand Kayser, at British Industries House, Marble Arch, London, W.1, at 8 p.m.

XUM

By courtesy of the Watford Foundry Company Limited

W'BRO' RIXON'S No.3 Foundry Iron

In the foundry illustrated above, thin-walled rain-water pipes are being produced with Rixon's W'bro' Foundry Pig Iron.

FLUIDITY

The high phosphorus content of this iron ensures the fluidity necessary to secure clean, sharply-moulded light castings. The analysis is as follows:—

	Per cent
Silicon	3.29
Sulphur	0.025
Phosphorus	1.65
Manganese	0.34
Graphitic Carbon	3.52
Combined Carbon	0.12
Total Carbon	3.64

The Stanton Ironworks Company Limited, Near Nottingham

Raw Material Markets

Orders placed for iron and steel are still in good volume, and, with prospects of the Government's expansion programme providing further activity, the present condition of the market should be maintained. There has been a decrease in the number of inquiries for pig-iron since the prices were advanced, but this was expected, as consumers were well covered before the changes were made. Deliveries are on a large scale.

Pig-Iron

MIDDLESBROUGH.—Available supplies of Cleveland iron are readily absorbed. Inquiries in this area continue to flow on a good scale, and contracts have been arranged at the new prices. The export market is not extinct, but contracts are difficult to negotiate. Home transactions are now regulated by the new schedule of prices, No. 3 Cleveland G.M.B. being uniformly quoted at 70s. per ton delivered either in the Middlesbrough or Falkirk areas, 72s. delivered North-East Coast, and 73s. delivered Glasgow.

It has been the general opinion for some time in this district that the agreed minimum prices of hematite would be increased, and further strength has been given to this belief by the sharp rise that has taken place in coke quotations. Makers of hematite are fully sold to the end of June. The export trade is still almost negligible, but after the home requirements are satisfied there is very little iron available for shipment. Prices are unchanged, but manufacturers are not anxious to enter into forward contracts at the current quotations, which are based on No. 1 East Coast hematite at 71s. per ton in the Middlesbrough zone.

LANCASHIRE.—The falling off in the amount of forward contracting continues to be noticeable, and these conditions are likely to exist for several weeks, as contracts already arranged represent a large tonnage. Machine-tool firms, heavy electrical engineers, the jobbing foundries, and the majority of the general and speciality engineering concerns are taking satisfactory tonnages into consumption, while the textile machinists are slightly better placed. For delivery to users in the Lancashire price zone, Staffordshire, Derbyshire and Lancashire brands of No. 3 iron equal to Derbyshire are all quoted at 78s. per ton, with Northamptonshire at 76s. 6d., and Scottish No. 3 at about 83s. East Coast hematite ranges from 80s. 6d. to 81s. per ton, and West Coast material is on offer at around 81s., both delivered equal to Manchester.

MIDLANDS.—The amount of new business in ordinary foundry pig-iron is limited. Satisfactory quantities are entering this district both for the light and heavy castings trades. Stocks are being consumed at a steady rate, for, in most cases, demand is in excess of the output. The controlled quotations are 72s. 6d. for Northants No. 3 and 75s. for Derbyshire, Lincolnshire and North Staffs No. 3. The figures include delivery to Birmingham and Black Country stations, and large consumers receive a small rebate. Forge iron is 5s. per ton below these prices, and an increased demand has been noted for this grade. Business in the hematite market has been on a good scale, and rumours concerning further alterations in quotations are in circulation. West Coast is quoted at £4 4s. 6d. for mixed numbers, East Coast at £4 3s. 6d. for No. 3, and Welsh at £4 3s. for mixed numbers. The prices for special irons vary a great deal, according to quality, etc. Low-phosphorus iron is offered at between 89s. and 92s. 6d., medium-phosphorus 75s. to 80s. 6d., and special refined pig at £5 7s. 6d. to £7 10s., delivered to this area.

SCOTLAND.—Prospects in the pig-iron market are considered to warrant an optimistic outlook. Further shipbuilding contracts have been placed and there is every hope of more work for the Admiralty. Business is chiefly concerned with small tonnages at the present time. The official minimum for No. 3 foundry is 74s. f.o.t. furnaces, with 2s. 6d. extra for No. 1. There is considerable activity in the light-castings section of the trade and the outlook is definitely promising. No. 3 Cleveland iron is quoted at 70s. f.o.t. Falkirk and 73s. f.o.t. Glasgow, with other English foundry iron at 1s. 3d. per ton below these prices. Steelworks continue to be well employed. The quotations for steelmaking irons are unchanged at:—Mixed numbers Scottish hematite, 73s. 6d.; mixed numbers West Coast hematite, 74s.; mixed numbers East Coast hematite, 74s.; basic, British and Indian, 70s. (less 5s. rebate), all delivered f.o.t. steelworks here.

Coke

There is a considerable demand for foundry coke and at the present time there are more purchasers than sellers. Slow deliveries are being reported and it is obvious that the possibility of a strike in the coalfields is influencing consumers. It would not be surprising if further advances were made in prices and meanwhile quotations are firm. For delivery in Birmingham and district best Durham coke is quoted between 38s. and 41s., while Welsh is from 34s. to 45s. Scottish coke is on offer in limited quantities at about 41s. 6d. per ton delivered the Birmingham district.

Steel

The satisfactory conditions ruling in the steel trade have been well maintained, and in some departments the volume of business shows signs of expanding, says the official report of the London Iron and Steel Exchange. The many public development schemes which have been announced promise to provide a considerable volume of work for the industry and will probably lead to an increase in production. The supplies of semi-finished steel materials seem scarcely sufficient to meet requirements, although lately the British production of this class of steel has been increased. Most of the producing works, however, are unable to accept orders except for delivery several weeks ahead, and are reluctant to undertake fresh commitments. In the finished-steel section of the market the business in most departments appears to be expanding, although on the export side trade is slow in developing.

Scrap

Good heavy melting steel scrap remains at 52s. 6d. per ton on the Cleveland market, but a rise is anticipated at any moment. The demand for machinery cast-iron scrap remains unabated at the advanced figure of 57s. 6d. Supplies of clean, light cast iron at 45s. per ton are scarce. Iron and steel scrap continues to have a keen demand on the Midland market. Heavy machinery cast iron in handy sizes is at 57s. 6d. and good heavy is at 50s., while clean light cast iron is at 47s. 6d. Short, heavy steel scrap, as used in the foundries, is at 57s. 6d. per ton, delivered works. Quotations on the Lancashire market for all qualities of scrap are firm and business is active. Cast-iron scrap of good machinery quality is available at from 50s. to 55s. per ton, according to grade, and inclusive of delivery to Lancashire foundries. On the Scottish market there is a greatly increased call on cast-iron scrap by local foundries. Supplies of this material are by no means plentiful. A good demand also exists for heavy steel scrap and the price of this is expected to be advanced in the near future. Good, heavy machinery cast-iron scrap, in pieces not exceeding 1 cwt., is quoted between 58s. 6d. and 60s. Heavy mild-steel melting scrap, in furnace sizes, remains at 50s., while heavy basic continues to be quoted at 5s. per ton below this figure.

Metals

Copper.—This metal has proved rather disappointing during the past week. The recovery which was noticeable in the market following the return to power of the National Government, has not developed according to expectations. The weekly review of the metal markets issued by Messrs. Rudolf Wolff & Company states that "confidence has been shaken by political events on the Continent, the strained relations between China and Japan, and threatened labour troubles in the coal industry of this country, for which reasons buyers have been inclined to await the turn of events, and the easier tendency has at times precipitated a little selling and liquidation. Sales, however, have at no time been heavy, and the market maintains a firm undertone, for basic conditions continue to be reported satisfactorily in respect of consumption and also with regard to the statistical position. Once the situation clears, prices should undoubtedly recover."

Daily market prices :—

Cash.—Thursday, £34 17s. 6d. to £34 18s. 9d.; Friday, £35 3s. 9d. to £35 5s.; Monday, £35 5s. to £35 6s. 3d.; Tuesday, £35 5s. to £35 6s. 3d.; Wednesday, £35 2s. 6d. to £35 3s. 9d.

Three Months.—Thursday, £35 5s. to £35 6s. 3d.; Friday, £35 11s. 3d. to £35 12s. 6d.; Monday, £35 12s. 6d. to £35 13s. 9d.; Tuesday, £35 12s. 6d. to £35 13s. 9d.; Wednesday, £35 10s. to £35 11s. 3d.

Tin.—In this country demand has been of small extent, but the actual absorption of the metal continues to be at a high rate. Continental demand will, undoubtedly, suffer a temporary decrease through the imposition of sanctions against Italy. The latter country made strenuous efforts to procure a stock of tin before the sanctions came into force. Buying in the United States has only been on a moderate scale this week, but consumers have only small stocks, and once the state of the market becomes more settled, an extensive buying movement should follow.

Metal Exchange quotations were as follow :—

Cash.—Thursday, £224 5s. to £224 15s.; Friday, £224 10s. to £225; Monday, £221 to £222; Tuesday, £221 to £222; Wednesday, £221 10s. to £221 15s.

Three Months.—Thursday, £212 to £212 10s.; Friday, £212 5s. to £212 10s.; Monday, £211 to £211 5s.; Tuesday, £211 10s. to £211 15s.; Wednesday, £212 to £212 5s.

Spelter.—This metal has developed a rather easier tone, due to the coalfield crisis and also to the dispute in the Far East. Consumers' needs do not amount to any great tonnage, and the quantity of forward buying is very restricted. Deliveries in the United States are reported to be on a good scale, but new business is restricted. The future of this market does not promise any great change for some considerable time.

Official quotations were as follow :—

Ordinary.—Thursday, £16 1s. 3d.; Friday, £16 1s. 3d.; Monday, £16 3s. 9d.; Tuesday, £16 2s. 6d.; Wednesday, £16 2s. 6d.

Lead.—The position of this metal weakened with that of other metals, but statistically the market remains satisfactory, and a recovery has been seen. With the building industry still active, there is little cause for depression in the lead market. In the United States stocks continue to be lowered, and deliveries are very satisfactory.

Day-to-day quotations :—

Soft Foreign (Prompt).—Thursday, £17 10s.; Friday, £17 15s.; Monday, £17 16s. 3d.; Tuesday, £18 1s. 3d.; Wednesday, £18 1s. 3d.

Contracts Open

Huddersfield, December 4.—Cast-iron pipes, from 1½-in. to 12-in. internal diameter, for the Town Council. Mr. W. Armitage, waterworks manager, 24, Ramsden Street, Huddersfield.

Johannesburg, January 6.—Steelwork, etc., for the brass and foundry at Salt River, for the South African Railways and Harbours. The Department of Overseas Trade. (Reference T.Y. 5505.)

Calcutta, January 16.—Cast-iron pipes and specials to B.S.I. Specification No. 78, Current Edition, for the Indian Stores Department. The Department of Overseas Trade. (Reference T.Y. 5514.)

Glanford Brigg, December 9.—Cast-iron and spun-iron pipes, specials, etc., for the Rural District Council. Mr. J. H. Haiste, chartered civil engineer, Middleton Chambers, Lowgate, Hull. (Fee £3, returnable.)

Burnham-on-Sea, December 3.—180 yds. of 4-in. cast-iron rising main and 610 yds. of 2-in. air main, for the Urban District Council. Mr. W. H. Chowins, engineer and surveyor, Public Offices, Burnham-on-Sea. (Fee £2, returnable.)

Lexden, December 13.—250 tons (cast weight) or alternatively 195 tons (spun weight) of 4-in. and 3-in. cast-iron pipes (class C), with five tons of special pipe castings, for the Lexden and Winstree Rural District Council. Messrs. Sands & Walker, Milton Chambers, Nottingham. (Fee £2 2s., returnable.)

THERE HAVE BEEN several important changes in the management of the Singer Manufacturing Company at Clydebank. Mr. Donald Graham, who has for a considerable number of years been cashier to the firm, has been appointed secretary in place of Mr. Murdoch, who became general manager on the death of Mr. Rickey. Mr. Graham's position is to be filled by Mr. Robert Bulloch, who was assistant cashier.

RESOURCES

NAL BLACK

CK GANISTER

nd the Armitage Mines, Deepcar

acture of Ground Ganister

NOTHING BETTER FOR THE LINING OF CUPOLAS THAN A REALLY HIGH CLASS GROUND GANISTER HAS EVER YET BEEN DISCOVERED — CHEAP "PRICE CUT" RUBBISH IS DEAR AT ANY PRICE

ike Deepcar Ganister"

FINAL COST ——————→ INFINITELY CHEAPER

With entire freedom from trouble and worry

ACTORIES LTD.

E, SHEFFIELD

Telegrams : Genefax, Sheffield.

OFFICE :
Adelphi, W.C.

Telegrams :
Genefax, Rand, London.

GLASGOW OFFICE :
156, St. Vincent Street, C.2.

Telephone : Central 5250.
Telegrams : Genefax, Glasgow.

RAW MATERIALS—PRICE LIST

(Wednesday, November 27, 1935)

COPPER

	£	s.	d.
Standard cash	35	2	6
Three months	35	10	0
Electrolytic	39	0	0
Tough	37	15	0
Best selected	38	5	0
Sheets	66	0	0
India	49	5	0
Wire bars	39	12	6
Ingot bars	39	12	6
H.C. wire rods	43	5	0
Off. av. cash, Oct.	35	5	2 13/16
Do., 3 mths., Oct.	35	12	5 1/16
Do., Sttlmnt., Oct.	35	5	2 1/16
Do., Electro, Oct.	39	19	4 2/3
Do., B.S., Oct.	39	1	4 2/3
Do., wire bars, Oct.	40	6	6 2/3
Solid drawn tubes			10½d.
Brazed tubes			10½d.
Wire			6½d.

BRASS

Solid drawn tubes	9¾d.
Brazed tubes	11¾d.
Rods, drawn	8½d.
Rods, extd. or rlld.	5d.
Sheets to 10 w.g.	7½d.
Wire	7¾d.
Rolled metal	7⅛d.
Yellow metal rods	5d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	221	10	0
Three months	212	0	0
English	221	10	0
Bars	223	0	0
Straits (nom.)	223	10	0
Australian (nom.)	221	10	0
Eastern	218	5	0
Banca (nom.)	221	10	0
Off. av. cash, Oct.	227	8	10 3/13
Do., 3 mths., Oct.	217	9	1 1/13
Do., Sttlmt., Oct.	227	6	11 1/13

SPELTER

	£	s.	d.
Ordinary	16	2	6
Remelted	15	5	0
Hard	13	5	0
Electro 99.9	18	13	9
English	17	2	6
India	14	10	0
Zinc dust	19	10	0
Zinc ashes	4	15	0
Off. aver., Oct.	16	11	1 1/3
Aver. spot, Oct.	16	8	9 1/3

LEAD

	£	s.	d.
Soft foreign ppt.	18	1	3
Empire (nom.)	18	16	3
English	20	0	0
Off. average, Oct.	18	4	2 5/13
Average spot, Oct.	18	4	2 5/13

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	24	10	0
Do., V.M. ex-whse.	25	10	0
Rods	29	0	0

ANTIMONY

	£	s.	d.		£	s.	d.
English	79	0	0	to	80	0	0
Chinese, ex-whse.					66	0	0
Crude, c.i.f.					35	0	0

QUICKSILVER

Quicksilver	11	15	0	to	12	5	0

FERRO-ALLOYS AND STEEL-MAKING METALS

	£	s.	d.
Ferro-silicon—			
25%	8	17	6
45/50%	12	15	0
75%	17	17	6
Ferro-vanadium—			
35/50%	12/8 lb. Va.		
Ferro-molybdenum—			
70/75% carbon-free	4/6 lb. Mo.		
Ferro-titanium—			
23/25% carbon-free	9d. lb.		
Ferro-phosphorus, 20/25%	£18 0 0 to £20 0 0		
Ferro-tungsten—			
80/85%	3/- lb.		
Tungsten metal powder—			
98/99%	3/3 lb.		
Ferro-chrome—			
2/4% car.	33	0	0
4/6% car.	21	15	0
6/8% car.	21	0	0
8/10% car.	21	0	0
Ferro-chrome—			
Max. 2% car.	33	10	0
Max. 1% car.	36	5	0
Max. 0.70% car.	37	5	0
70%, carbon-free	9½d. lb.		
Nickel—99.5/100%	£200 to £205		
"F" nickel shot	£184	0	0
Ferro-cobalt, 98/99%	5/6 lb.		
Metallic chromium—			
96/98%	2/5 lb.		
Ferro-manganese (net)—			
76/80% loose	£10 15 0 to 11 5 0		
76/80% packed	£11 15 0 to 12 5 0		
76/80% export	(nom.) £9 15 0		
Metallic manganese—			
94/96% carbon-free	1/3 lb.		

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 1/16 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ⅛ in.	3d. lb.
Do., under ⅛ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.		£	s.	d.
South Wales—							
Heavy steel	3	0	0	to	3	2	6
Mixed iron and steel	2	15	0	to	2	17	6
Heavy cast iron	2	14	0	to	2	15	0
Good machinery	2	17	6	to	3	0	0
Cleveland—							
Heavy steel					2	12	6
Steel turnings					1	17	6
Cast-iron borings					1	7	6
Heavy cast iron					2	12	6
Heavy machinery					2	17	6
Midlands—							
Light cast-iron scrap					2	7	6
Heavy wrought iron					3	0	0
Steel turnings					1	16	6
Scotland—							
Heavy steel					2	10	0
Ordinary cast iron	2	18	6	to	3	0	0
Engineers' turnings					2	0	0
Cast-iron borings					2	0	0
Wrot-iron piling	3	2	6	to	3	5	0
Heavy machinery	3	1	0	to	3	2	6

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	29	0	0
Brass	19	0	0
Lead (less usual draft)	15	10	0
Tea lead	12	0	0
Zinc	9	0	0
New aluminium cuttings	72	0	0
Braziery copper	26	0	0
Gunmetal	27	0	0
Hollow pewter	155	0	0
Shaped black pewter	120	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—

Foundry No. 1	72/6
Foundry No. 3	70/-
„ at Falkirk	70/-
„ at Glasgow	73/-
Foundry No. 4	69/-
Forge No. 4	69/-
Hematite No. 1	71/-
Hematite M/Nos.	70/6

N.W. Coast—

Hem. M/Nos. d/d Glas.	74/-
„ d/d Birm.	84/6
Malleable iron d/d Birm.	115/-

Midlands (d/d Birmingham dist.)—

Staffs No. 4 forge	71/-
„ No. 3 fdry.	75/-
Northants forge	68/6
„ fdry. No. 3	72/6
„ fdry. No. 1	75/6
Derbyshire forge	71/-
„ fdry. No. 3	75/-
„ fdry. No. 1	78/-

Scotland—

Foundry No. 1, f.o.t.	76/6
„ No. 3, f.o.t.	74/-
Hem. M/Nos. d/d	73/6

Sheffield (d/d district)—

Derby forge	68/6
„ fdry. No. 3	72/6
Lincs forge	68/6
„ fdry. No. 3	72/6
W.C. hematite	86/-

Lancashire (d/d eq. Man.)—

Derby fdry. No. 3	78/-
Staffs fdry. No. 3	78/-
Northants fdry. No. 3	76/6
Cleveland fdry. No. 3	78/-
Dalzell. No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	83/-
Clyde, No. 3	83/-
Monkland, No. 3	83/-
Summerlee, No. 3	83/-
Eglinton, No. 3	83/-
Gartsherrie, No. 3	83/-
Shotts, No. 3	83/-

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	12	6	to	9	15	0
Nut and bolt iron	7	17	6	to	8	7	6
Hoops	10	10	0 and up.				
Marked bars (Staffs) f.o.t.				12	0	0	
Gas strip	10	10	0 and up.				
Bolts and nuts, ¾ in. × 4 in.	15	2	6 and up.				
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	9	5	0	to	9	7	6
Chequer plts.				10	7	6	
Angles				8	7	6	
Tees				9	7	6	
Joists				8	15	0	
Rounds and squares, 3 in. to 5½ in.				9	7	6	
Rounds under 3 in. to ⅜ in. (Untested)				8	12	0	
Flats—8 in. wide and over				8	12	6	
„ under 8 in. and over 5 in.				8	17	6	
Rails, heavy	8	5	0	to	8	10	0
Fishplates	12	5	0	to	12	10	0
Hoops (Staffs)				9	7	0	
Black sheets, 24g. (4-t. lots)				11	5	0	
Galv. cor. shts. („)				13	5	0	
Galv. flat shts. („)				13	15	0	
Galv. fencing wire, 8g. plain				14	10	0	
Billets, soft	5	10	0 and up.				
Billets, hard	6	17	6	to	7	2	6
Sheet bars	5	10	0	to	5	15	0
Tin bars	5	10	0	to	5	15	0

PHOSPHOR BRONZE

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	12½d.
Rods	11½d.
Tubes	14d.
Castings	12½d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7¼
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	21.31
No. 2 foundry, Valley	19.50
No. 2 foundry, Birm.	14.50
Basic, Valley	19.00
Malleable, Valley	19.50
Grey forge, Valley	19.00
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	27.00
Sheet bars	28.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.80
Steel bars	1.85
Tank plates	1.80
Beams, etc.	1.80
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.10
Wire nails	2.40
Plain wire	2.30
Barbed wire, galv.	2.80
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
„ furnace	19/- to 20/-
Durham foundry	21/- to 22/-
„ furnace	18/- to 19/-
Scotland, foundry	28/-
„ furnace	25/-

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	18/9
„	28×20 „	37/6
„	20×10 „	27/-
„	18¾×14 „	19/6
C.W.	20×14 „	15/6 to 16/-
„	28×20 „	33/6 to 34/6
„	20×10 „	22/9 to 23/-
„	18¾×14 „	15/9 to 16/-

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.		£	s.	d.
Pig-iron	6	0	0	to	7	0	0
Bars-hammered, basis	16	0	0	to	16	10	0
Bars and nail-rods, rolled, basis	15	15	0	to	16	0	0
Blooms	10	0	0	to	12	0	0
Keg steel	30	0	0	to	31	0	0
Faggot steel	18	0	0	to	23	0	0
Bars and rods dead soft, st'l	10	0	0	to	12	0	0

All per English ton, f.o.b. Gothenburg
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

	£	s.	d.		
Nov. 21 ..	34	17	6	dec.	8/9
„ 22 ..	35	3	9	inc.	6/3
„ 25 ..	35	5	0	„	1/3
„ 26 ..	35	5	0	No	change
„ 27 ..	35	2	6	dec.	2/6

Electrolytic Copper

	£	s.	d.		
Nov. 21 ..	39	0	0	dec.	5/-
„ 22 ..	39	5	0	inc.	5/-
„ 25 ..	39	5	0	No	change
„ 26 ..	39	5	0	„	„
„ 27 ..	39	0	0	dec.	5/-

Standard Tin (cash)

	£	s.	d.		
Nov. 21 ..	224	5	0	inc.	5/-
„ 22 ..	224	10	0	„	5/-
„ 25 ..	221	0	0	dec.	70/-
„ 26 ..	221	0	0	No	change
„ 27 ..	221	10	0	inc.	10/-

Tin (English ingots)

	£	s.	d.		
Nov. 21 ..	224	10	0	No	change
„ 22 ..	224	10	0	„	„
„ 25 ..	221	0	0	dec.	70/-
„ 26 ..	221	10	0	inc.	10/-
„ 27 ..	221	10	0	No	change

Spelter (ordinary)

	£	s.	d.		
Nov. 21 ..	16	1	3	dec.	2/6
„ 22 ..	16	1	3	No	change
„ 25 ..	16	3	9	inc.	2/6
„ 26 ..	16	2	6	dec.	1/3
„ 27 ..	16	2	6	No	change

Spelter (Electro, 99.9 per cent.)

	£	s.	d.		
Nov. 21 ..	18	11	3	dec.	3/0
„ 22 ..	18	12	6	inc.	1/3
„ 25 ..	18	15	0	„	2/6
„ 26 ..	18	13	9	dec.	1/3
„ 27 ..	18	13	9	No	change

Zinc Sheets (English)

	£	s.	d.		
Nov. 21 ..	24	5	0	dec.	2/6
„ 22 ..	24	5	0	No	change
„ 25 ..	24	10	0	inc.	5/-
„ 26 ..	24	10	0	No	change
„ 27 ..	24	10	0	„	„

Lead (English)

	£	s.	d.		
Nov. 21 ..	19	10	0	dec.	10/-
„ 22 ..	19	15	0	inc.	5/-
„ 25 ..	19	15	0	No	change
„ 26 ..	20	0	0	inc.	5/-
„ 27 ..	20	0	0	No	change

AVERAGE MONTHLY PRICES OF STEEL BOILER PLATES IN ENGLAND

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1898	6 10 0	6 8 9	6 8 9	6 10 0	6 15 0	6 18 9	6 17 6	6 17 6	7 2 6	6 15 0	7 0 0	7 5 0	6 15 8½
1899	7 5 0	8 0 0	8 2 6	8 2 6	8 5 0	8 5 0	8 12 6	8 12 6	8 15 0	8 15 0	9 2 6	9 5 0	8 17 8½
1900	9 5 0	9 5 0	9 7 6	9 10 0	9 12 6	10 5 0	10 5 0	10 5 0	10 5 0	10 0 0	9 15 0	9 15 0	9 15 10
1901	9 5 0	9 5 0	8 15 0	8 10 0	8 10 0	7 10 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	7 15 0	8 3 11
1902	7 7 6	7 0 0	7 12 6	7 12 6	7 12 6	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 9 7
1903	7 10 0	7 10 0	7 15 0	7 5 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	6 17 6	7 3 11½
1904	6 12 6	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 11½
1905	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 17 6	6 10 0	7 5 0	8 0 0	8 0 0	7 1 3
1906	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 0 10
1907	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 8 4
1908	7 10 0	7 10 0	7 10 0	7 5 0	7 5 0	7 5 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	7 3 9
1909	7 0 0	7 0 0	7 0 0	7 0 0	7 0 0	6 15 0	6 15 0	6 15 0	7 0 0	7 0 0	7 0 0	7 0 0	6 18 9
1910	7 0 0	7 0 0	7 1 3	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 5 0	7 10 0	7 10 0	7 10 0	7 5 1
1911	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 14 0	7 10 4
1912	7 18 9	8 0 0	8 0 0	8 7 6	8 10 0	8 10 0	8 10 0	8 15 0	8 16 3	9 0 0	9 2 0	9 5 0	8 11 2½
1913	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	9 5 0	8 19 0	8 15 0	8 5 0	7 15 0	7 15 0	8 17 0
1914	7 15 0	7 15 0	7 15 0	7 13 9	7 10 6	7 5 0	7 0 0	8 0 0	8 2 6	8 5 0	8 5 0	8 5 0	7 15 11½
1915	8 14 0	9 10 0	9 17 6	10 10 0	10 10 0	11 0 0	11 0 0	11 0 0	11 0 0	11 4 0	12 0 0	13 0 0	10 15 5½
1916	13 0 0	13 0 0	13 0 0	12 15 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 12 11
1917	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1918	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1919	13 0 0	15 0 0	15 0 0	15 0 0	19 5 0	19 17 6	21 0 0	21 10 0	21 10 0	21 10 0	21 15 0	23 10 0	18 9 9
1920	26 0 0	28 0 0	28 5 0	28 10 0	29 5 0	30 0 0	30 0 0	30 0 0	30 10 0	31 0 0	31 0 0	31 0 0	29 9 2
1921	30 5 0	29 0 0	25 0 0	25 0 0	25 0 0	23 0 0	21 0 0	20 10 0	19 0 0	17 10 0	16 0 0	14 16 0	22 1 9
1922	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 1 8	13 10 0	12 15 0	12 10 0	12 10 0	12 10 0	12 6 9	13 10 9
1923	12 8 9	13 6 0	14 0 0	14 0 0	14 0 0	14 0 0	13 12 6	13 0 0	13 0 0	13 0 0	13 0 0	13 10 0	13 9 1½
1924	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	14 0 0	14 0 0	14 0 0	13 5 0	13 5 0	13 10 11
1925	13 5 0	13 5 0	13 5 0	13 1 0	12 15 0	12 15 0	12 15 0	12 15 0	12 7 6	11 14 0	11 10 0	11 10 0	12 11 5½
1926	11 10 0	11 10 0	11 10 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 5 0	11 6 3
1927	11 5 0	11 5 0	11 5 0	11 5 0	11 2 6	11 0 0	11 0 0	11 0 0	10 16 0	10 10 0	10 10 0	10 10 0	10 19 0½
1928	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0
1929	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 10 0	10 5 0	10 1 3	10 1 3	10 1 3	10 1 7	10 6 8½
1930	10 2 9	10 3 5½	10 3 9	10 3 9	10 3 6	10 2 6	10 2 6	10 2 6	10 2 2½	9 19 6	9 16 3	9 16 3	10 1 6½
1931	9 15 0	9 15 0	9 15 0	9 10 11	9 6 9	9 5 0	9 7 0	9 7 9½	9 8 9	9 5 9	9 5 6	9 9 6	9 9 4
1932	9 5 0	9 2 6	8 18 6	8 17 6	8 16 6½	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 16 3	8 17 10
1933	8 10 0	8 10 0	8 10 0	8 8 9	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 6 0	8 7 6	8 6 10½
1934	8 8 1½	8 10 7½	8 16 6	8 17 6	8 6 3	8 6 3	8 5 7½	8 5 0	8 5 0	8 5 0	9 6 3	9 6 3	8 11 6½
1935	9 6 3	9 6 3	9 6 3	9 6 3	9 6 3	9 6 3	9 6 3	9 6 3	9 6 3	9 6 3	—	—	—

TN ORANGE

WINCHESTER HOUSE, OLD BROAD STREET, LONDON, E.C.2.
Telegrams:- "ALKALIZE, STOCK, LONDON" Phones:- LONDON WALL 7955 (5 LINES)

AC GARNET

FINE ORANGE

COPYRIGHT ESTBD 1880. REGISTERED TRADE MARK LIMPET

BUTTON

WILLIAM JACKS & Co

Partners: J Gray Buchanan Stewart Barry R Russell Walker

FINEST ORANGE

SHELLAC

RUBBER QUICKSILVER MICA

WHITE

PALE LEMON

THE METAL EXCHANGE
Telegrams: "JACKS, METMA, LONDON" LONDON, E.C.3. Phone: LONDON WALL 7955

FINE WHITE

SITUATIONS VACANT AND WANTED

COREMAKERS' Foreman seeks position; wide experience in oil engines, motor trades, also general engineering and repetition castings; keen rate fixer; supervision of male and female labour. Good results guaranteed. Good organiser and live wire.—Box 478, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY cleaning room, welding and heat-treat Foreman. Long experience in large modern foundries, grey iron, malleable and steel, is free to consider offers of employment from progressive firm.—Box 466, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

SUCCESSFUL Commercial Manager, desiring change, seeks position where 30 years' general engineering and foundry experience could be profitably applied. Age 45; excellent references; salary, £300.—Box 482, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT FOREMAN required for iron and brass foundry. Applicants should have technical as well as practical qualifications and be under 40 years of age. Write, stating full particulars of experience and wages required, to the Secretary, CONSETT IRON CO., LTD., Consett, Co. Durham.

ASSISTANT Foundry Chemist required to control cast-iron mixtures and assist in chemical laboratory. Experience with alloy cast irons desirable.—Apply, giving full particulars with regard to age, etc., to MESSRS. THE SHEEPBRIDGE STOKES CENTRIFUGAL CASTINGS COMPANY, LIMITED, Sheepbridge Works, Chesterfield.

FOREMAN Coremaker required, used to oil-sand cores and expert experience in use of core-applying machines. State full experience, age and wage required, to Box 480, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY

WANTED, new or used ½-ton Steel Converter or Electric Furnace Plant, for small steel castings.—Box 484, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOR SALE.—Two Rotary Core Machines, in good condition; Glyso and Spermolin make. —Full particulars to Box 486, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

THREE "Rapid" pneumatic Squeezers; plain-squeeze type; no pattern draw. Price £9 each.—ALEX. HAMMOND, Foundry Machinery Merchant, Slough.

30-40 CWT. Heroult-type Electric Furnace for sale; recently installed and absolutely as new. Primary voltage, 11,000 v. Cheap to save removal. Reason for selling—foundry closing down.—Box 472, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

THOS. W. WARD LTD.

All-geared Massive Vert., DRILLING M/C. (Shanks), 3½" dia. spdle.; 12 speeds and reverse for tapping; 18" col., to centre of spdle.

18" str., trav., HEAD SHAPER (Hulse), 8' 0" bed; 2 T-slotted table 24" x 18"; swivelling head.

5 NISSEN TYPE STEEL BUILDINGS, 550' x 40' x 19' 10" high.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).

ALBION WORKS, SHEFFIELD.

MACHINERY—*Continued*

TWO roller-bearing, double-ended Fettling-shop Grinders, complete with new wheels 24 in. by 3 in. on each machine. Thoroughly modern machines in perfect condition; as new. Offered cheap.—ALEX. HAMMOND, Foundry Machinery Merchant, Slough.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

SANDBLAST PLANTS

Room Plants, sizes 12 ft. x 12 ft., 12 ft. x 9 ft. and 6 ft. x 6 ft., made up in cast-iron sections.

Barrel Plants, 30 in. dia. x 36 in. long and 30 in. dia. x 18 in. long rotary barrels.

Cabinet Plants, in sizes 4 ft. x 4 ft. x 4 ft., 36-in. dia. and 30-in. dia. operators' cabinets.

Most of the above by Tilghman and complete with Air Compressors.

HAND MOULDING MACHINES

By Adaptable, Pridmore, Darling & Sellars, etc.; Squeezers by Utard (unused), Samuelson and Britannia, also Farwell Universal Type.

Ladles, Grinding Machines, Exhaust Fans, Blowers, Air Compressors and 500 Electric Motors and Dynamos.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.

CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.

'Phone: Broadwell 1359.

MISCELLANEOUS

WEIGHING MACHINES.

3-TON Avery Weighing Machine, with 24-in. gauge rails.

1-ton Avery Weighing Machine, ordinary platform type.

½-ton Avery Weighing Machine, portable type with loose weights.

5-cwt. Avery Weighing Machine, portable type with loose weights.

2-ton Avery Crane Weigher, dial type.

10-ton Denison Crane Weigher.

15-ton Denison Crane Weigher.

20-ton Denison Crane Weigher.

30-ton Denison Crane Weigher.

All above in stock, offered cheap. Re-stamped ready for use.

ALEX. HAMMOND,
Foundry Machinery Merchant,
SLOUGH.

'Phone: 287 SLOUGH

SAND PLANT

Herbert Whizzer, large size. £48.
Brealey Disintegrator, NEW. £26.
Pneumatic Riddles, Jackman type. £9 each.

SANDBLAST PLANT

BARREL PLANT by Tilghman, *as new*, 60" × 40". Price £240.

NEW 8' × 8' ROOM PLANT, complete. Price £230.

CAST IRON ROOM PLANT, 12' × 9', complete with 400 cu. ft. motor-driven compressor for A.C. current, in new condition. Cheap.

Several small complete barrel plants in stock.

Genuine Stevenson 30-ton Crane Ladle, NEW. Price £75.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

MISCELLANEOUS—*Continued*

WE ARE WIREWORKERS making strong Foundry Sieves and Riddles, Fettlers' Wire Brushes of all kinds, Core-Cleaning Brushes, ½ in. to 4 in. dia., etc. Buy direct and get the right article at the right prices.—WILLIAM OLSEN, LTD., Hull.

SELECT YOUR MACHINE FROM THE LARGEST STOCK OF HIGH-CLASS SECONDHAND MOULDING MACHINES IN THE WORLD

Practical Advice Free

THE COLEMAN FOUNDRY EQUIPMENT Co LTD
156, STRAND, LONDON, W.C.2.

GANISTER

Purchase your supplies from actual Producers with over 50 years' reputation

Scientifically treated, specially ground Ganister for Cupolas, Iron & Steel Works, &c.

SPECIAL LADLE GANISTER

TRIAL BAGS FREE
Quotations on application

The ASTBURY SILICA CO.
CONGLETON, Cheshire
Est. 50 Years

IDAHO PINE YELLOW PINE

PRIME & PATTERN GRADES
½" to 3" thick
Width up to 24" wide
All free of centre heart and shake

CHETHAM TIMBER Co., Ltd.,
70, FINSBURY PAVEMENT, LONDON, E.C.2
Metropolitan 7418